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SECOND

ANNUAL REPORT

OF THE

FISHERY BOARD FOR SCOTLAND

For the Year ended 31*st December* 1883.

Presented to both Houses of Parliament in pursuance of Act 45 and 46 Vict., cap. 78.

EDINBURGH:
PRINTED BY NEILL & COMPANY.

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1884.

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TO THE RIGHT HONOURABLE

SIR WILLIAM VERNON HARCOURT, M.P.,

Her Majesty's Principal Secretary of State for the Home Department.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 2*nd June* 1884.

SIR,

Introductory Statement.

We have the honour to submit our Second Annual Report of the Fisheries under our superintendence. It includes statistics for the year 1883, with the exception that, for reasons given, those relating to fish sold fresh are for the twelve months ended 31st March last.

Fishery Districts.

As stated in our First Annual Report, the coasts of Scotland are divided into twenty-six fishery districts, at each of which a fishery officer is stationed, and at some of the more important stations there is also an assistant officer. Their names and boundaries, together with the residences of the fishery officers, will be found in that Report, along with a list of the fishing villages or creeks on the east coast.

Matters requiring Legislation.

We had the honour to receive a letter from you, dated 15th December 1882, inviting an expression of our opinion on matters under our administration which appeared to require immediate legislation, and there was submitted to you, on 24th May 1883, a report on some of these subjects, which was afterwards laid before Parliament. That report mainly dealt with the regulations respecting the *Herring Brand*, and the restrictive provisions of the *Fishery Acts*, both of which subjects appeared to be of pressing importance. As was then stated, however, there were other matters, such as *Salmon Fisheries*, *Harbours*, and *Marine Police*, which had been under our consideration, but which required time for their investigation. Regarding these we shall speak in the course of this Report.

SCIENTIFIC INVESTIGATIONS.

A. *Summary of Observations made in Britain as to the Natural History of the Herring previous to* 1882.

Importance of Fishery Industry early recognised.

At a very early period the fishery industry was recognised as of national importance, and as worthy of the fostering care of the Legislature, and for a century, at least, the habits of the herring and other food fishes have attracted the attention of many eminent naturalists.

Claims of Crown.

In the twelfth century it appears that the right to fish for herrings was vested in the Crown, and for several centuries afterwards those engaged in the industry in Scotland, though willing to hand over their takes to Dutch and other foreign vessels, claimed for themselves the exclusive right of fishing. Notwithstanding this claim, the Dutch had 2000 herring 'busses' in 1667 fishing in the North Sea, off the Scottish coast.

Number of Dutch Busses in 1667.

Restricted sale of Herring in 15th century.

During the fifteenth century it was found necessary to limit the sale of herring to foreigners, that the people at home might be supplied.

Royal Commission on British Fisheries in 1630.

In 1630 a Royal Commission was appointed to consider and report how the British fisheries might be rendered more beneficial by the formation of a General Fishing Company. Immediately after the Union the fishing industry almost ceased to exist, owing apparently to the enactment of salt duties; and in 1727 an Act was passed by which the Board of Trustees for Manufactures and Fisheries was created for encouraging the fisheries in Scotland. This Board, in addition to generally superintending the fisheries, was empowered to pay bounties to herring 'busses' at the rate of from 30s. to 40s. per ton, and to offer small premiums to the fishermen who first discovered herrings during each season at the different parts of the coasts, and also, in course of time, to pay a bounty of 2s. per barrel to boats not fitted out for the tonnage bounty. During the five years 1804–1808 over £56,000 was paid as bounties to the fishermen—on an average a little over £11,000 a year.

Board of Trustees formed in 1727.

Bounties offered.

£56,000 paid in five years.

Commissioners of British White Herring Fishery appointed.

In 1808 'An Act for the further Encouragement and better 'Regulation of the British White Herring Fishery,' was passed, and Commissioners were appointed to carry it into effect. The Commissioners had charge of the fisheries of the whole of the British coasts, and at a later date of the Isle of Man; and in addition to granting bounties, they had a sum of £3000 placed at their disposal by way of encouraging the fishermen to use larger boats, so that they might proceed further to sea.

Increase in take of Herring

Under the new Commissioners there was during the first four years of their existence an increase in the take of herring, and at the same time a saving of nearly £62,000 of public money.

Fishery Officers appointed.

The Commissioners at the outset stationed officers at the chief fishing centres, around both the Scottish and English coasts, and at a later date appointed two officers to the port of London, from which large consignments of herring were despatched to the Continent. In addition to the fishery officers, the Admiralty

provided a ship of war to assist in the work of superintendence, and in 1815, a cutter was obtained for use in the Firth of Forth. This cutter was afterwards made use of at other parts of the coast. Scientific Investigations. Fishery Cruisers.

The various officers were instructed, amongst other duties, to enforce the regulations as to the size of the mesh of the nets; and 'to take account of the quantity of salt, nets, barrels, and other 'stores, and of herrings landed, of barrels of white herrings branded 'for the bounty of 2s. per barrel, of repacked white herrings shipped, 'to be carried coastwise for exportation, and of white herrings 'shipped for exportation.' Instructions to Officers.

It is claimed in the Reports of the Commissioners, as the result of many undersized nets being 'seized, condemned, and publicly 'burned,' that the size and quality of the herring found in the market were greatly improved. What influence the Commissioners had in improving the supply of fish, and in developing the fisheries, cannot well be estimated, but there can be no doubt that in collecting statistics they rendered, as is now universally recognised, an immense service. As a matter of fact, the statistics of the Scottish herring fishery were, until recent years, the only reliable statistics in existence, and now they are admitted to be of sufficient value to have justified the existence of the Board of Fisheries, even if the other work performed were left out of consideration. From the statistics collected, a valuable chart (Appendix A, Table VIII.) has been prepared by Mr Robertson, one of the clerks of the Board, which shows at a glance the barrels of herring cured, exported, and branded from 1809 to 1882. Results of seizing undersized nets. Value of Fishery Statistics. Chart showing Curing, &c., of Herring since 1809.

In 1820 the fishery officers were instructed to take the cod and ling fishery under their charge; in 1821 the bounty for encouraging deep sea fishing was withdrawn; and in 1830 all the bounties were repealed, and a portion of the money set aside for the erection of piers and harbours. In 1839 the Secretary of the Board of Manufactures was appointed Secretary of the Fishery Commissioners. Soon after this the Commissioners were led to depart from their routine work, and direct their attention to some of the too long neglected scientific problems connected with the fisheries. Cod and Ling Fishery Bounties repealed.

In 1836 the sprat fishing in the Firth of Forth greatly increased, and the small nets used led to complaints being made that the herring fishing was being destroyed. The Commissioners wisely appealed to Dr Knox, in order to learn if sprats were, as was asserted, young herring. Dr Knox having reported that sprats were distinct from the herring, the Commissioners at first decided not to interfere; but when in 1837 there were more herring than sprats in the Firth, they at once with the aid of a gunboat put a stop to the sprat fishing. This question led the Commissioners to take an interest in the young herring, and in 1842, influenced by the facts that reached them regarding the natural history of the herring, they felt the necessity of taking steps to protect the herring fry, and to prevent small herrings being caught as sprats. By way of gaining some definite information about the growth, food, and habits of the herring, Mr Henry Goodsir made arrangements to carry on investigations in the Firth of Forth. With this object in view, Mr Goodsir spent what time he had at his disposal, during 1843–4 on the Island of May. From the observa- Beginning of scientific work. Nature of Sprats determined. Protection of Herring Fry. Inquiry by Mr Henry Goodsir.

Scientific Investigations.

tions made it was ascertained that the food of the herring consisted chiefly of small crustaceans; unfortunately the inquiry was discontinued when Mr Goodsir joined the ill-fated Franklin expedition.

Crustacea chief food of Herring.

The work of investigation was taken up, some time afterwards, by Mr James Wilson, who prepared a careful account, with illustrations, showing how sprats differed from young herrings. From the Report of 1846 it is evident the Commissioners were familiar with the fact that herring ova sink, and adhere to whatever they come in contact with at the bottom. This important fact was certainly known at the beginning of the century, for Dr Walker, Professor of Natural History in the University of Edinburgh, in an essay published in *The Transactions of the Highland Society* in 1803, points out that the herring selects a bottom 'neither rocky nor sandy,' but consisting 'of gravel more or less coarse,' at a depth usually of 10 to 12 fathoms, and that the fry 'are known to be between one 'and two inches long in the month of June' and about three or four inches long in September, when they 'desert the places where they 'are bred.' Dr Walker, however, adds that 'the manner in which 'they deposit their spawn is unknown,' and that 'they are 'not known to spawn anywhere in shallow water,' or at any time from the beginning of March till after the beginning of October, and further that 'the spawn deposited between the 1st of 'November and the 1st of March comes to life in the end of April 'or beginning of May.' In 1846 it was believed that the spawn lay on the Ballantrae Bank 'to a very great depth,' and the Commissioners then not only believed the bank should be protected, but that the trammel net fishing, so destructive to the spawn, should be prohibited. But the trammel net fishing they had no power to prevent, and it was only with difficulty that in 1847 they succeeded in arresting what was considered a great destruction of young herring in the Firth of Forth.

Nature of Herring Ova.

Essay on Herring by Dr Walker.

Ballantrae Bank and Trammel Nets.

English Stations given up. Brand Fee instituted.

In 1850 the English stations were discontinued, and in 1859 a charge of 4d. a barrel was made for branding; but, notwithstanding this charge, the brand was quite as much taken advantage of as before.

Inquiries by Dr Ballot and by Board of Trade.

In 1856 another step in the right direction was taken, at the request of Dr Buys Ballot, who invited those engaged in the great herring fishery to make observations, in order, if possible, to ascertain the circumstances likely to lead to the most profitable fishing, as well as to enable them to make a herring chart. This was followed by the Board of Trade issuing instructions for the collection of herring from all parts of the coasts of Scotland whenever they could be fallen in with, at different periods of the year, observations being noted with each sample according to a form which had been revised by Professor Huxley, F.R.S. Twelve boxes of samples were in this way collected and forwarded to the Board of Trade, along with the relative observations; but there is no record of the samples having been submitted to examination.

Complaint against Trawling on Spawning Grounds.

A new form of complaint reached the Commissioners in 1860, from the Pittenweem, Anstruther, and other fishermen, who protested against the trawling for white fish on the spawning ground lying off their shores. The Board caused the ground opposite

Anstruther, Pittenweem, and St Monance to be dredged by the fishermen, and 'what was obtained by the dredging was put into 'seven bottles, and examined by Dr Allman, Professor of Natural 'History in the University of Edinburgh,' who reported, 'that 'no evidence is afforded in favour of the view that the mode of 'fishing by which they were obtained is likely to exert an injurious 'influence on the spawning ground of fish;' adding, that 'the only 'instance in which any of the specimens contained matter which 'could unhesitatingly be asserted to be fish spawn, was one in 'which the substance examined is stated to have been taken out 'the stomach of a flounder, and one, therefore, which throws no 'light upon the question regarding the operation of certain modes 'of fishing injuring the spawning grounds.'

Scientific Investigations.

Investigation ordered by Board of Fisheries.

Although the Commissioners seem to have been perfectly conscious of the great want of information as to the habits of the food fishes, they always, as soon as the complaints ceased, abandoned the inquiries they had instituted, so that little or no useful knowledge was gained; and as a result sooner or later a new agitation began amongst the fishermen, to be followed by another inquiry, or the appointment of a Commission, and so it has continued until the present day. Had the Board been provided with the necessary funds to carry on continuous investigations as to the mode and time of spawning, the nature of the eggs, and of the food and migrations of the herring, and other useful fishes, not only would an immense amount of valuable information have been obtained, but the great expense of Commissions of Inquiry might have been avoided. It cannot, however, be matter for surprise that uninterrupted investigations were not carried on by the Fishery Commissioners twenty years ago, when it is remembered that at the present time, notwithstanding the example of other States, the influence of the Fishery Exhibitions, and the united demand of all interested in the Scottish Fisheries for more knowledge, the Treasury have not yet provided the necessary funds.

No continuous investigations carried on by Board.

Sufficient Funds not yet provided to new Board.

One of the many agitations arose in 1860, and as a result Professor Allman and Dr Lyon Playfair, C.B. (both Fishery Commissioners) were appointed to inquire into the effects of beam trawling on the herring spawn deposited in the 'Fluke Hole' off Pittenweem, and about the same time Dr Lyon Playfair, C.B., and Vice-Admiral Henry Dundas (also a Fishery Commissioner) were requested 'to 'make investigations into the claims and conditions of the sprat 'fishermen' of the Firth of Forth. The result of this latter inquiry was that regulations were passed which confined the sprat fishermen to the waters west of a 'line' drawn from the beacon at North Ferry to the beacon at South Queensferry, passing to the westward of Inchgarvie.

Effects of Trawling at Fluke Hole.

Inquiry as to claims of Sprat Fishermen.

The agitation continuing, a Royal Commission, consisting of Dr Lyon Playfair, C.B., Professor Huxley, F.R.S., and Lieut.-Colonel C. Francis Maxwell, was appointed in 1862, to inquire as to 'the 'operation of the Acts relating to Trawling for Herring on the 'Coasts of Scotland.' The Report of this Commission is especially interesting, because it contains the results of the inquiries made by Professor Allman during the winter and spring of 1862, as to the nature of herring ova, and also because it includes a valuable

Royal Commission appointed in 1862.

Scientific Investigations.

chapter on the natural history of the herring. Professor Allman's investigations proved that the spawn of the herring 'was deposited 'on the surface of stones, shingle, and gravel, and on old shells and 'coarse shell sand, and even on the shells of small living crabs, and 'other crustacea,' and that it 'adhered tenaciously to whatever 'matter it happened to be deposited on.'

Experiments by Professor Allman.

Herring spawn found at Isle of May.

The spawn examined by Professor Allman was obtained for the first time on the 6th of March, on the east and west sides of the Isle of May, from depths varying from 14½ to 21 fathoms, and was plentiful until the 13th March, but had almost entirely disappeared by the 25th. The spawn was not deposited until about 65 days after the appearance of the herring in the Firth, and it was never found except at the Isle of May. Professor Allman, who succeeded in hatching many of the eggs obtained, states 'that the 'incubation probably continues during a period of between 25 'and 30 days.'

Spawn hatched.

Commissioners conclude there are two great spawning periods.

In the chapter on the natural history of the herring, it is pointed out for the first time that there are two principal spawning periods—an autumn period, with August and September as the two principal months, and a spring period, with February and March as the principal months; and it is further mentioned that when spawning, the herrings 'lie in tiers covering square miles of sea bottom, and so 'close to the ground that the fishermen have to practise a peculiar 'mode of fishing in order to take them,' and 'when once their 'object has been attained, and they have become *spent fish*, the shoal 'rapidly disappears.'

Conclusions arrived at by Meteorogical Society of Scotland, as to influence of temperature, &c.

Following the example of Professor Ballot, the Meteorological Society of Scotland in 1873, at the suggestion of the Marquis of Tweeddale, began a series of inquiries, with the view of determining how far the temperature of the sea and other meteorological conditions influence the migration of the herring. After examining the weekly returns of fishing sent to the Board by the fishery officers during the six previous years (1867–1872), the Society reported that 'the results appeared to bring out an evident con-'nection between the exceptional atmospheric temperatures and the 'migration of the herring, although it would be premature to draw 'any general conclusion from the facts collected;' and further that 'it appeared that during the periods when good or heavy catches 'were taken the barometer was in the great majority of cases high 'and steady, the winds light and moderate, and electrical phenomena 'wanting; and, on the other hand, when catches were low, the 'observations often indicated a low barometer, strong winds, 'unsettled weather, and thunder and lightning.'

The Fishery Board continued to obtain, through its fishery officers and the commander of the fishery cruiser, daily registers of the weather, and the temperature of the sea at different periods of the herring fishery. From the registers and information supplied for the years 1874–75, the Committee of the Meteorological Society arrived at the following, amongst other conclusions—(1) that the catch of herrings is less during any season, with a high temperature than during a corresponding season, with a low temperature; (2) that if the temperature is higher in one district than another, the catch of herrings is greatest in the district with the

lowest temperature; and (3) that when the surface temperature is higher than the temperature lower down, the herring seek the deeper water, always apparently preferring a low to a high temperature. Scientific Investigations.

These conclusions, the Committee believed, were confirmed by the observations made during the following years, and tables were prepared showing the relations between fluctuations of temperature and the catch of herring.

The Meteorological Society has not been able to furnish any report of the observations made since the fishing season of 1878.

From the above statement of the work done by or in connection with the Board of Fisheries, it will be seen that no attempt was made, either by continuous investigations carried on by naturalists, or by utilising the fishery cruisers or the large staff of fishery officers, to make a thorough and exhaustive study of the migrations, time of spawning, development, and rate of growth of the herring. It should, however, be remembered that three important facts have been established, viz.,—(1) by Professor Allman and Dr M'Bain, in March 1862, that herring spawn was deposited on stones, shingle, and gravel, and that it adhered firmly in masses to these various objects at the bottom until the fry escaped—this spawn was obtained for Professor Allman by the Fishery cruiser 'Princess Royal,' partly by means of divers, and partly by dredging on the east and west sides of the Isle of May, in from 14 to 21 fathoms water. Officers of old Board not utilised for making investigations. Important facts established:— 1. Nature of spawn.

(2) By the Royal Commission (of which Professor Huxley was a member), on the operation of the Acts relating to Trawling for Herrings on the Coast of Scotland, which reported in 1863, 'that 'there are two great spawning seasons every year, one in spring and 'another in autumn,' the spring spawning reaching a climax in February and March, and the autumn spawning reaching a climax in August and September. 2. Periods of spawning.

(3) By Mr Henry Goodsir that the food of the herring consisted chiefly of small crustacea. 3. Food of Herring.

B. *Short Summary of Work done by other Countries previous to* 1882.

Important observations were made on the structure of the herring during the time of Linnæus, Cuvier, and Weber, but comparatively little has been done since, and a good account of the anatomy of the herring, more especially of the skeleton, does not yet exist. No complete account of structure of Herring.

The investigations begun by Professor Allman in 1862 have been greatly extended by the Commissioners appointed by the German Government in 1865, to investigate the biological and physical conditions of the West Baltic. Owing to the Franco-German war, little was done until 1871, but since then, by making systematic and continuous observations, important results have been obtained, some of which throw much light on the habits of the inshore or spring herring of the Baltic. Work of German Fish Commission.

In 1874 the eggs of the inshore herring were found in abundance in the almost fresh water of the Schlei, at a depth of about 3 feet, attached to Potamogeton and other fresh water plants. Eggs were taken from herring caught in the Schlei, and artificially fertilised and hatched. Eggs of inshore Herring fertilised and hatched.

Scientific Investigations.

Effects of temperature on rate of development.

By studying the effects of temperature during development, it was found that with a temperature of 53° Fahr. and upwards, the eggs hatched in about eight days, while with a temperature of 38° Fahr. the hatching was delayed until about the fortieth day. When the temperature was from 50° to 51°·8 Fahr., the hatching occurred on the eleventh day, but when the eggs were placed during the first three days of development in water with a temperature of 33°·8 to 35°·6 Fahr. (1° to 2° C.), and then removed to water with a temperature varying from 50° to 53°·6 Fahr. (10° to 12° C.), the hatching was delayed from four to five days.

On the other hand, it was found that cold had a greater retarding influence immediately before the time of hatching than it had during the early stages of development, for eggs which had been developing in water at 51°·8 to 53°·6 (10° to 12° C.), and which would have hatched in two days when introduced into water with a temperature of 35°·6 Fahr. (2° C.), did not hatch for twelve days, the time being thus increased from ten to twenty days by the change of temperature. It was also found that in the brackish water of the Baltic, while the eggs developed satisfactorily at a temperature of 33°·8 Fahr. (+ 1° C.), the development did not proceed in a normal way when the temperature was reduced to 30°·56 Fahr. (−0°·8 C.). These experiments indicate that any of the spawning grounds of the winter herring might be rendered unsuitable by the approach of cold polar currents; in other words, that the disappearance of herring from their usual spawning banks has perhaps sometimes resulted from a lowering of the bottom temperature.

Size of fry when hatched.

Other experiments showed—(1) That the length of the fry when hatched varied with the time required for development, the fry measuring about $\frac{1}{5}$ of an inch (5·4 mm.) when the development was rapid, but measuring about $\frac{1}{3}$ of an inch, and having a somewhat smaller yolk bag, when the development was prolonged.

Food of fry.

(2) That the fry of spring herring, which were hatched in fourteen days, and kept in the open water of Kiel Bay, with a temperature varying from 51°·8 to 68° Fahr. (11° to 20° C.) lost their yolk bag in three days, and in five days began to feed on embryos of molluscs (such as Mya, Cardium, Tellina, Rissoa, Lacuna, and Ulvæ), and later on copepods.

(3) That the fry grew according to the following table:—

Rate of growth of young Herring.

Fry	1 month	after fertilisation	of eggs were	10–11	mm. in length.
„	2 months		„	17–19	„
„	3 „		„	30–35	„
„	4 „		„	48–58	„
„	5 „		„	65–70	„

Compared with what was believed to be the natural rate of growth in Kiel Bay, the fry under observation grew during the earlier months very slowly; but on taking steps to provide them with an abundant supply of their natural food, they rapidly made up for the slowness of growth, and at the end of the fifth month they were as large as the fry of a similar age that had developed naturally in the Bay.

Whitebait stage at 3rd month.

(4) That about the end of the third month the scales begin to appear, and the fry reach the 'whitebait' stage. At what rate they

grow after the fifth month, or when they spawn for the first time, or when they reach the stage of full-grown herring, we at present have no information. Scientific Investigations

In addition to these valuable observations, for which we are indebted to Dr H. A. Meyer, the Reports of the German Commissioners contain amongst other papers of interest, two by Kupffer on the early stages of the development of the herring, one by Heincke on the varieties of the herring, which goes to show that the winter herring differ from the autumn herring, and another on the structure of the herring. The various memoirs will be referred to in detail, when the subjects to which they refer are discussed at length in this or in future Reports. Work on development and structure of Herring.

In addition to the work done by the German Commission, a number of observations have been made by Norwegian and Swedish naturalists.

In 1860 the Norwegian Parliament voted a sum for the investigation of the Norwegian fisheries, and Axel J. Bœck was commissioned to investigate the herring fisheries. Bœck found that herring congregated over large level portions of the bottom covered with gravel, in order to spawn; and he afterwards succeeded in dredging large lumps of roe mixed with gravel, and in proving that it was over these flat gravel-coated areas that the largest takes were obtained. From other observations, he concluded that herring never go far from the shore, and that they always move along certain channels; and further, that their movements are to a certain extent influenced by wind and the temperature of the air, the herring seeking deeper water when the temperature rises. Investigations by Norwegian Government. Roe found mixed with gravel.

In 1874 the results of observations on the herring fisheries made by Axel Ljungman, for the Swedish Government, were published. Ljungman found that the herring off the coast of Sweden spawned on rough ground and on clayey bottoms, when covered with aquatic plants, and that the 'small herring' began to spawn at the end of May or beginning of June. From studying the movements of herring, he concluded—(1) that they avoided the light, and for this reason were most active at the rising and setting of the sun; (2) that in stormy weather, especially with sea-winds, they sought deep water, while with ordinary land winds they approached the shore; and (3) that waters far from the ocean (*e.g.*, the Baltic) are never visited by great shoals. Observations by Swedish Government.

In 1878 the United States Commission (appointed in 1870 to institute inquiries as to the fisheries), which has done excellent work in connection with both fresh water and sea fisheries, made a number of experiments with herring eggs, and proved that they could be easily artificially fertilised and hatched. Herring Eggs hatched by United States Fish Commission.

C. *Work undertaken since the institution of the New Board.*

In 1882 the Board of British White Herring Fishery having been dissolved, the present Fishery Board for Scotland was established to carry on the work of superintending the fisheries, and, in addition, to 'take such measures for their improvemnet as the funds 'under their administration may admit of.' The Board soon discovered that without further information as to the habits and life Fishery Board for Scotland instituted.

Scientific Investigations.

history of the food fishes, it would be impossible to submit satisfactory reports to Parliament, either as to the improvement or as to the regulation of the fisheries, and hence it took steps soon after it was constituted to carry on scientific investigations. For this purpose a committee was appointed, consisting of Professor Cossar Ewart, Sir James R. Gibson Maitland, Sheriff Forbes Irvine, and J. Maxtone Graham, Esq.—Professor Ewart to be Convener.

Board appoints Committee to make investigations.

Gunboat applied for.

To enable the Board to undertake this important work, you were pleased to move the Admiralty to provide a gunboat for carrying on some preliminary inquiries as to the natural history of the herring during the autumn of 1883. Unfortunately, the gunboat was not granted until the great summer herring fishing had begun, and the result was that there was no time left to make the necessary arrangements, either as to obtaining funds or apparatus for carrying on the work. Under the circumstances, it was arranged that the expenses of the inquiry should be met out of the sum voted for travelling, and the use of the Scottish Zoological Station, which Mr G. J. Romanes, F.R.S., and Professor Cossar Ewart were good enough to offer, was accepted as a temporary laboratory. As complete arrangements as were possible having been made, Sir James R. Gibson Maitland and Professor Ewart joined the gunboat (H.M.S. 'Jackal,' Lieut. Prickett, R.N., Commander) provided by the Admiralty, at Invergordon on the 6th August, and after taking the dredges and other appliances on board, proceeded to examine first the inshore and afterwards some of the offshore spawning grounds, in the Moray Firth.

Investigation begun on 6th August in Moray Firth.

Nature of Work carried on.

This work consisted chiefly in examining the various banks where the herring were spawning, or had been known to spawn. At each bank several 'stations' were made which usually meant—(1) noting the depth, and taking the surface and bottom temperatures; (2) collecting a sample of water from the bottom and of the mud and sand brought up with the sounding lead; (3) noting the nature of the surface fauna, and examining and preserving the characteristic animal and vegetable forms brought up by the trawl dredges and tangles. To assist in this work Mr J. T. Cunningham, B.A., and Mr J. Gibson, D.Sc., were invited to join the expedition.

'Vigilant' relieves 'Jackal.'

At the beginning of September the Board's cruiser ('Vigilant') relieved the 'Jackal,' and continued the investigation as far as the weather would admit until the 6th October.

Material collected.

During the two months in which the work was prosecuted a considerable number of specimens were collected from the various spawning beds. These were conveyed to the University of Edinburgh, and arranged into their various groups, and afterwards put into the hands of naturalists for identification.

Reports not yet received.

It has not been possible to obtain reports of all the specimens collected, and Dr Gibson has not completed his elaborate Report on the physical and chemical characters of the spawning beds, or of the samples of water or temperature taken, hence an account of the Autumn's work must be held over until next year. It may, however, be mentioned now that the observations made during the expedition clearly showed that the inshore ground of the Moray Firth is remarkably well adapted for serving as spawning beds for the herring; there is an abundance of hard ground, and the surface

General results of Autumn's work,

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waters literally team with myriads of minute forms, such as the herring fry require for food during the earlier months of their existence. The absence of herring from the Guillan and other once much frequented banks cannot therefore be accounted for either by saying that the bottom is no longer suitable for the deposit of eggs, or that the surface waters no longer contain the food required for the newly-hatched herring. During the coming autumn it will be a matter of the first importance for the Board to deposit on one of the inshore banks some millions of fertilised eggs. By doing this a number of extremely interesting problems may be solved. For example, if the following year the bank is frequented by a shoal of comparatively small herring, it may be inferred—(1) that they are the produce of the eggs deposited the former season; (2) that herring, like salmon, when about to spawn, instinctively seek their birthplace; (3) that the migration of herring is limited, and that in course of time special varieties of herring may have been formed at different parts of the coast; and (4), what is of even of more importance, that when any particular spawning ground is deserted, instead of waiting thirty, fifty, or more years, until some accident brings another shoal, the nucleus of a new shoal may be formed without waiting, and the fishing restored in a comparatively short period. At the same time, it is evident from the observations of last year, that it is equally important that the development of herring eggs should be studied in deep water. It has been again and again asserted that herring eggs develop in from 60 to 100 fathoms, but there is an entire absence of proof of this statement; and now that the herring fishing is chiefly carried on in deep water at 50 to 100 miles from the shore, that, in other words, there is no longer an abundance of herring inshore, it is of vital importance to settle finally, as Dr Francis Day, our greatest authority on fish, has so often urged, whether the eggs develop, and, if so, whether the fry are sufficiently strong to survive and obtain what nourishment they require in the open sea.

Experiment suggested for next Autumn.

Hatching should be studied in deep water.

In addition to examining the herring spawning grounds, a preliminary survey was made of the mussel beds of the Dornoch, Cromarty, and Inverness Firths. From this inquiry it was evident that all three firths were remarkably well adapted for producing mussels, and that with a little care they might also be made available for the cultivation of oysters. It was ascertained that the mussel beds of the Dornoch Firth yield a considerable sum annually to the authorities of Tain, and that the chief reason why the mussel beds generally had not been farmed, as they are in France, resulted from the exorbitant charges for surveying, &c., made by the Board of Trade before any attempt at artificial culture could be attempted. The Board hopes that ere long you will be pleased to take steps to have the control of both oyster and mussel beds transferred from the Board of Trade to the Fishery Board for Scotland. If this were done, the Board feels convinced that in a few years, by granting leases of the beds at low rates, and by arranging for a small charge for the necessary preliminary survey, the three firths mentioned would yield as many mussels as supply the whole east of Scotland, and thus provide a plentiful supply of bait to the fishermen, the absence of which is often

Survey of Mussel Beds.

Mussel Culture hindered by Board of Trade regulations.

Fishery Board should have charge of Mussel Beds.

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at present not only a great hardship to those immediately concerned, but also a great loss to the country. An important step in assisting in the development of mussel culture would be the introduction into this country of the use of wattles; but an experiment of this kind, like the other scientific work of the Board, will be impossible unless a special grant is obtained.

Introduction of Wattles for Mussel culture.

Some observations were made as to the food of the herring, and a number of experiments were made with a view of determining the best means of hatching large numbers of artificially fertilised eggs. These observations will be referred to in the next Report.

Board recognises great necessity for continuing and extending investigations.

Perhaps the most important result of the autumn's work is that the Board has come to feel keenly—(1) that almost everything has still to be learned regarding the habits and life history of our food fishes; (2) that if provided with even limited funds, the Board, with the assistance of the officers already in its service, will be able to remove not a little of this ignorance; (3) that the fishermen, fish-curers, and the country generally, are profoundly interested in the scientific, as well as in the practical side of the fishery industry, and prepared to do their utmost to secure for the Board whatever may be necessary for its successful prosecution; and (4) that on the Board the responsibility in great part falls of reversing the following verdict, passed on Britain at the recent London Great International Fishery Exhibition, viz.:—'It is a very striking fact that the one point on

Lamentable ignorance of habits, &c. of fish.

'which all speakers at the conferences held during the past summer 'at the Exhibition were agreed was this—that our knowledge of 'the habits, time, and place of spawning, food peculiarities of the 'young, migrations, &c., of the fish which form the basis of British 'fisheries is lamentably deficient, and that without further know-'ledge any legislation or attempts to improve our fisheries by better 'modes of fishing, or by protection or culture, must be dangerous, 'and indeed unreasonable.'

Board has large staff of officers capable of assisting in scientific work.

It is a matter of great importance that the Board has been led to appreciate more fully the fact, that it has in its service a large number of intelligent officers, not only familiar with all practical aspects of the fishery industry, but in addition, extremely interested in the work of investigation; and that it has been led to recognise that, owing to the want of scientific impulse, splendid opportunities have been lost in the past for investigating the habits and life history of our food fishes. It is a source of regret that the suggestion made by the Royal Commission, which reported in 1863, was not acted upon. This Commission pointed out that results, important both to science and practice, might be otained by making the fishery officers keep 'natural history registers on a systematic plan.'

Having recognised the responsibility of its position, and feeling convinced that the country was not only alive to the necessity of making observations, but extremely anxious that the inquiry instituted in the autumn should be continued and extended, the Board took steps to utilise to the utmost all the means at its disposal for carrying on the work. Accordingly, in the early winter,

Instructions sent to Fishery Officers.

instructions were sent to the various officers stationed around the coast, requesting them to direct their attention during the winter more especially to the sprat and herring fisheries, to forward

samples of the takes, and to collect material to enable the Scientific Committee to determine, as far as possible, the nature of the food of the herring during the different months of the year at the various fishing stations. For circulars, see Appendix F, No. VIII. As the result of these instructions, a large collection of herring stomachs has been made, which, when examined, will settle to a great extent the very important food problem. A rough examination of the material collected has been sufficient to show— (1) That the food consists chiefly of small crustacea, a single stomach sometimes containing as many as 50 specimens of mysis, varying from one inch to one and a quarter inches in length; (2) That, in addition to crustacea, many other creatures serve as food for the herring, *e.g.*, some of the stomachs preserved contain four or five half-grown sprats, while others are filled with the delicate almost transparent worm-like sagitta; (3) That although the herring feeds as opportunity offers during the spawning period, the claims of hunger are a very secondary consideration, only 1 or 2 per cent. of the mature herring examined having any food in their stomachs, while herring taken shortly after spawning have, with few exceptions, their stomachs well filled. During February and March, for example, the spawning herring, when taken on the Ballantrae Bank, had seldom any food in their stomachs; while in December and January the immature herring, taken in the same district, were often in the 'Gutpock' condition; and at the present time, about two months after spawning, nearly all the herring taken have their stomachs distended with crustacea,—crustacea being sufficiently abundant at present on the Ballantrae bank to give the water a distinctly red colour. It is therefore evident that, as soon as spawning is over, the herring begin to feed, in order to make up for the great loss that occurs during the spawning period; and that having recovered from their shotten condition, they begin to store up nourishment, chiefly in the form of fat in the muscles and liver, and along the sides of the intestine, by way of preparing for the next spawning period.

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The food of the Herring.

Little food taken during spawning period.

Herring feed freely after spawning.

An account of the herring food collected during a whole year will be given in the next Report.

By examining and making outlines of the samples of herring sent from the various fishing stations, some conclusions have been arrived at, as to the varieties and the migration of the herring (Appendix F, No. IV.). It has been found impossible, however, to make much progress with this part of the work, the Board being unable to provide any assistance to the Scientific Committee, either by way of helping in the work of organisation, or in carrying on the investigations.

Varieties and migration of Herring.

Want of assistance.

The inquiry may, when extended, show that there are several local varieties of herring around our coasts, and that there are in addition the deep sea herrings which visit our shores to deposit their spawn, and further that during the spawning period their movements are entirely under the control of what may be called the spawning instinct; while at other times their movements are chiefly regulated by the supply of food. Hence, when a fishing station is situated in the vicinity of a spawning bed (*e.g.*, Ballantrae), there is sure to be, once a year, a more or less successful fishing; whereas if

Influence of spawning instinct.

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a fishing station is in the vicinity of feeding ground, the fishing will depend on the presence or absence of food, which may be regulated by currents, temperature, or other obscure phenomena.

Specimens forwarded by Officers.

Of the specimens forwarded by the fishery officers the most interesting are the portions of sea-firs (chiefly *Hydrallmannia*) and sea-weeds (chiefly *Laminaria*), with clusters of herring eggs attached. In almost every instance the note accompanying the specimen mentioned that 'the eggs forwarded were believed by the 'fishermen to be those of the haddock,' sometimes those of the cod or whiting. With few exceptions, the sea-firs were brought up by the long line fishermen, and in some instances they were said to have come from a depth of 40 fathoms. In connection with these specimens the Board has the satisfaction of mentioning that the Fishery officers and others have reported that, owing to the inquiries instituted, the fishermen were taking quite a new interest in their work. At several fishing stations the herring eggs brought up by the long lines were successfully hatched by the fishermen, and they have been making experiments with the eggs of the cod and haddock, about which there has been so much contention. In a recent letter from Mr Murray, the Board's officer at Stonehaven, it is mentioned that the skipper (Main) and crew of the 'Orient' (A, 214) convinced themselves that ripe cod spawn did not sink to the bottom. They expressed 'roe and milt into a bucket of sea water and 'were surprised to find that the fertilised spawn instead of sinking, 'floated like cream on the surface.' The herring spawn has been chiefly sent from Girvan, Eyemouth, Peterhead, Wick, Stonehaven, and Aberdeen. The specimens sent show what is of great importance, that from August to the present time (28th of May), herring have been constanly spawning off the Aberdeenshire coast, so that we have not only spawning going on all the year round at one part or other of the coast—at Wick in July, at Eyemouth in October, at Cornwall in January, at Ballantrae in March, and at Stornoway in June—but we have herring actually spawning at the same place during at least ten months of the year.

Herring Eggs attached to sea-weeds.

Interest of Fishermen in investigations, and their experiments with Herring and Cod Eggs.

Herring spawn throughout the year.

In addition to the specimens of herrings and sprats, and the samples of food forwarded, the fishery officers and the commander of the 'Vigilant,' have obtained a number of interesting zoological specimens, which, when examined, will enable us to understand better the nature of the bottom and the enemies of the food fishes at the various parts of the coast. Amongst the specimens several are of special interest, *e.g.*, (1) a fine Torpedo taken off Lybster; (2) an Opah from Lerwick, which measured over 4 feet in length; (3) a Turbot, of a dark colour on both sides, and with an eye on each side of the head, sent from Anstruther; (4) a Blenny, new to British waters, taken off St Abb's Head; and (5) a Comber, taken off Shetland. The torpedo was presented to the Museum of Science and Art, the opah is being examined by Professor Turner, F.R.S., the turbot and comber are still in the possession of the Board, and the blenny is in the possession of Professor M'Intosh of St Andrews.

Other specimens obtained, —Torpedo, Opah, Turbot, Blenny and Comber.

Board orders inquiry as to destruction of young Herring.

Early in winter it was alleged by herring fishermen and others that a wholesale destruction of young herring was being carried on in the Firth of Tay and elsewhere, by the sprat fishermen, which,

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if allowed to continue, would still further diminish the inshore herring fishing. The Board having taken the matter into consideration, appointed a Committee, consisting of Mr Thoms and Professor Cossar Ewart, to institute inquiries. The Committee found that a similar inquiry had been made in 1861 by Dr Lyon Playfair, C.B., and Vice-Admiral Henry Dundas (members of the former Board), who reported that 'the sprat is specifically distinct 'from the herring, and generally keeps in shoals by itself; but 'heavy tides frequently cause a mixture of sprats and young herrings. 'The proportion of herrings to sprats is at present only 1 per cent.; 'but sometimes the mixture is so great that there may be an equal 'proportion of the two species.'

Result of inquiry of 1861.

But finding that many fishermen and fish-dealers still insisted that sprats were young herring, and that it was generally believed that enormous numbers of immature herring were being destroyed, they decided to make investigations in order to finally settle the relation of the sprat to the herring, and to discover what the so-called destruction of immature herring amounted to. Professor Ewart having obtained samples of the takes from the Firths of Forth and Tay, and from the Inverness Firth, and finding, that while the percentage of young herring taken in the Firth of Forth and the Inverness Firth was, in most instances, little higher than in 1861, the percentage of herring to sprats in the Firth of Tay varied from 30 to 70 per cent., it was thought desirable to visit the Tay, and study the matter on the spot. Accordingly, Professor Ewart joined the 'Vigilant,' on the 23rd November last, and spent the early morning of the 24th, visiting, and carrying away samples of the takes from, the various 'bag-net' fishing boats, and he afterwards made inquiries at Dundee as to the amount of sprats which had been forwarded to the manure works at Montrose. The result of the inquiries showed—

Large number of Herring taken with Sprats in Firth of Tay.

Result of inquiry in Firth of Tay.

(1) That practically all the fish, from 1 inch in length to the size of a large cod or salmon, which entered the bag-net were captured, and that the net (some 140 feet in length) was large enough to secure over two tons of fish at a single haul.

(2) That 35 per cent. of the fish taken during the morning of the 24th were under $2\frac{1}{2}$ inches in length, and that 65 per cent. of the fish over 3 inches in length were young herring.

(3) That about 100 tons of fish caught by bag-net fishermen had been forwarded between the 10th and 16th November to the manure factory at Montrose, and that previous to the 24th of November somewhere about 44,000,000 young herring had been destroyed,—the 44,000,000 only bringing in about £150, while the same number of full herring would be worth when captured over £100,000.

Mr Matthews requested to continue investigation.

Mr Duncan Matthews was requested to continue the investigation, and the Board has received from him a valuable report (see Appendix F., No. III.), which, in addition to giving an excellent account of the structure of the sprat, and showing how it essentially differs from the herring, shows that while there is, in the mean time, little or no call for interference in either the Firth of Forth or in the Inverness Firth, the Board should have the power of preventing, when necessary, the fishing for sprats.

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From Mr Matthews' report it will be seen that examples of the takes of the fish caught by the sprat fishermen were examined practically every second day, during the months of December, January, and February, and that after examining over 9000 specimens, representing in round numbers a total take of 600,000,000 fish, under $5\frac{1}{2}$ inches in length, it was found that

Result of Mr Matthews' investigation.

1. The Moray Firth takes contained under 1 per cent. of young herring.

2. The Firth of Forth takes contained over $6\frac{1}{2}$ per cent. of young herring.

3. The Beauly Firth takes contained 15 per cent. of young herring.

4. The Firth of Tay takes contained over 21 per cent. of young herring.

The report further shows that (1) about 23,040,000 young herring were destroyed in the Moray and Beauly Firths; (2) 94,250,000 young herring were destroyed in the Firth of Tay, and that about 26,000,000 young herring were destroyed in the Firth of Forth, during the sprat fishing, giving a total destruction for the three Firths of 143,690,000 young herring, which if taken in autumn would yield about £400,000. Of these 109,950,000 were used as manure. The Board regrets not only that so many young herring have been destroyed, but also that so much valuable food has been wasted, and that the sprats, instead of being used for manure, have not, like the pilchards at Cornwall, been preserved as sardines. The Board thinks it will be advisable to continue the investigations as to the destruction of young herring for another year.

Estimated that 143,690,000 young Herring have been destroyed as Sprats.

When the food of the herring was under consideration, it was found that the structure and function of the various parts of the alimentary tract had not been fully studied, and hence Professor Stirling, D.Sc., of the University of Aberdeen, was requested to investigate these points. The result has been that the Board is able to present a valuable paper (see Appendix F., No I.) on the digestive process in fish. Although there has neither been time nor sufficient material for an exhaustive inquiry, some interesting results have already been obtained, the organ, *e.g.* which has hitherto been known as the 'crop' in the herring, has been found to be something more than a mere receptacle, and to correspond practically in structure to the large cardiac portion of the stomach of the mammal. When the inquiry has proceeded further we shall be able to give a comparative account of the digestive process in fish. This will be a valuable supplement to the papers on the food of fishes which the Board hopes to present in future Reports.

Prof. Stirling requested to study process of digestion in Fish.

Inspection of Ballantrae Bank ordered.

The Board, having learned that the winter fishing had begun on the Ballantrae Bank, requested Professor Cossar Ewart, on the 3rd March, to join the fishery cruiser H.M.S. 'Jackal' at Girvan, and inspect the spawning grounds. As the result of this inspection, a number of interesting observations were made.

Nature and extent of Bank.

The well-known Ballantrae Bank, which lies from 2 to 3 miles from the shore, at a depth of from 7 to 11 fathoms, and measures about 3 miles in length by about $1\frac{1}{2}$ miles in breadth, was found to be a glacial deposit, with the surface consisting chiefly of stones, gravel, and coarse sand, and coated here and there with patches

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of sea-weeds and *Sertularians*. The stones were chiefly lying on raised portions, while the sand and fine gravel were lying in basin-shaped cavities. Living on the bank were a number of echinoderms, molluscs, coelenterates, worms, and other invertebrates; while shoals of herring, followed by cod, dog-fish, porpoises, and dolphins, often occupied the water covering it. The temperature varied from 42° Fahr. at the surface to 43°5 Fahr. at the bottom. On several occasions herring spawn was dredged from the bank sometimes attached to comparatively small polished stones, at other times to large pieces of *Laminaria*, or to portions of *Sertularia*, but the greater part of the spawn was found forming a layer from a quarter to half an inch in thickness over a mixture of sand, fine gravel, and broken shells, which lay in the basin-shaped portions of the bank already referred to.

Herring eggs found on gravel, stones, &c.

Specimens of the spawn attached to the stones, gravel, sea-weeds, and sea-firs have been preserved, and some hundreds of thousands of the eggs taken up in the dredge were afterwards hatched in Rothesay Aquarium. In addition to determining the nature of the spawning ground, Professor Ewart was able to observe the natural process of fertilising and depositing the eggs; and he further succeeded in hatching a large number of eggs, which were artificially fertilised on board the 'Jackal.' On a subsequent occasion, a more thorough examination of the spawning ground was made by the use of a diving-bell, and at the same time thousands of herring fry were found on the surface, along with the eggs of the haddock, and an immense number of minute crustacea and other surface forms. For an account of the spawning grounds, and of the natural and artificial fertilisation of herring eggs, see Appendix F, No. IV. It may be mentioned that Professor Ewart has made considerable progress with an account of the structure of the herring; but, to prevent overcrowding, the part ready will not be incorporated in the present Report.

Eggs taken from bank hatched.

Method of depositing spawn studied.

Fry hatched from artificially fertilised eggs.

Board establishes Marine Station at St Andrews.

The Board, encouraged by the success which had attended the various inquiries it had instituted, took into consideration the propriety of making some experiments with flat fish, such as sole, turbot, and flounder. Recognising that St Andrews Bay was naturally extremely well adapted for experiments of this kind, and learning that Professor M'Intosh, F.R.S., who was engaged making investigations for H.M. Trawling Commission, was willing to do everything in his power to assist the Board in carrying on its scientific work, it was resolved to establish at St Andrews a small marine laboratory. This was all the more possible, as the municipal authorities of St Andrews were willing to place at the service of the Board at a small rent a wooden hospital, situated on the Bents, within a few yards of the sea. To enable the Board to undertake this, you were pleased to obtain the sanction of the Treasury to the application of a small sum (£335) for fittings and other expenses, and although the arrangements are not yet complete, a beginning has been made. Professor M'Intosh has already succeeded in hatching flat-fish from artificially fertilised eggs, and in showing that with the necessary appliances it would be possible to introduce into St Andrews Bay at a limited expense some millions of young turbot, sole, and flounders. An experiment of this kind

£335 voted for fittings.

Eggs of flat-fish fertilised and hatched.

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would be extremely valuable, as it would settle what is still a vexed question, whether it is possible to obtain results by the artificial cultivation of sea fish, at all comparable to those obtained by the artificial propagation of salmon and trout. Professor M'Intosh is experimenting with eggs of other food fishes, and with those of lobsters and sea-squids. Success with the latter might prove of great importance, as there is nothing that forms a more attractive bait at certain seasons of the year than sea-squids and other cephalopods.

Experiments with other eggs.

Insufficiency of funds for carrying on investigations.

Finding that the money placed at the disposal of the Board by Parliament was quite insufficient to meet the expenses of scientific investigations, you were pleased to move the Treasury for additional funds. Unfortunately, the Lords of the Treasury, failing to appreciate the importance of the scientific work of the Board, refused your request, and in a letter, dated the 10th December 1883, stated 'that no expense must be incurred for this 'service during the current year which cannot be met out of this 'year's vote for the Fishery Board as taken last session, for my 'Lords are not prepared to present any supplementary estimate 'for the Board.' Notwithstanding this decision, the Board ventured to make another appeal on the 21st of December, not only requesting that £300 required to meet the expenditure incurred during the autumn be voted, but also that funds be provided to enable the inquiry to be continued during the present year. To this their Lordships replied, that they were 'not prepared to present 'any supplementary estimate this year for the Board, as stated in 'the letter from this department of 10th ult., or to add to the 'estimate already sanctioned for next year.'

Treasury refused to give special grant.

While these negotiations were going on the Board received the usual printed circular asking if any supplementary vote was required for the service of the Board, to which in the peculiar circumstances a negative reply was sent. The reason for doing this was that the Treasury had twice refused to place on the estimates any additional sum for the expenses of scientific investigations, and also because these expenses were still forming a subject of correspondence with the Treasury.

Treasury suggests using surplus Brand Fees.

It may further be mentioned, that in a Treasury letter dated 18th January 1884, it was stated that unless this Board 'could suggest 'the diversion of a portion of the herring brand surplus to meet 'these expenses . . . the investigations should at once be suspended.' To this suggestion the Board, in a letter dated 19th February 1884, reluctantly acquiesced, in order to be in a position to meet the expenses already incurred, and to prevent the investigations being abruptly stopped; but at the same time the Board ventured to express a hope that the Treasury might be able to reconsider their decision. In this letter it was stated that 'in the interests of the 'public the Board would regret extremely if the prosecution of 'these investigations is suspended, for it is now recognised by the 'fishermen and all others concerned that the scientific work which 'the Board has undertaken is the most important that it can in the 'meantime prosecute. It is certain that any interruption of the 'inquiries begun will create great public dissatisfaction;' and it was also pointed out 'that if the Fishery Board is worth maintaining

Board again appeals for funds.

'at all, and if it is to be of any service to the valuable interests 'committed to its charge, it is impossible to avoid incurring expen- 'diture of a new character.' Scientific Investigations.

In reply to this communication, the Lords of the Treasury again declined to grant a special vote, stating, in a letter dated the 10th March, that they 'were not prepared to ask Parliament for a special 'grant of £1000 for the investigations of 1884–85, or to sanction 'any expenditure upon them which will cause an excess on the 'estimate of the Fishery Board for that year than what has already 'been approved by this department.' Special grant of £1000 refused.

While this correspondence was going on, and without the cognisance of the Board, the interest of those practically engaged in the fisheries in securing the continuance of scientific investigation was so great, that they spontaneously organised and addressed to the Treasury direct appeals for an adequate grant to the Board, and also urged that a suitable steam vessel might be placed at its disposal in place of the present sailing cruiser. As the result of this movement, the Board understands that petitions to the Treasury in support of these aids have been adopted and presented, not only by leading fish-curers and fishermen at upwards of twenty of the most important fishing centres on the Scottish coast, but also by such influential bodies as the Convention of the Royal Burghs of Scotland; and it is believed the whole of the Chambers of Commerce in Scotland have adopted a like course. Appeals for money made by Fish-curers, Fishermen, Convention of Royal Burghs, and Chambers of Commerce.

By a reference to the letters addressed to you as to the expenditure on these investigations, it will be seen that what was asked for was £300 to meet the expenses already incurred; £300 to enable the Board to continue the work in the meantime, and in addition a special grant of £1000 for future investigations. What the Lords of the Treasury have been pleased to sanction for scientific work is (1) the surplus out of the ordinary vote for the Fishery Board for the year 1883–84, amounting to £115; and (2) the transference of £785 from the surplus brand fees, *i.e.*, £900 in all. Of this £900 a sum of £300 was required to meet the expenditure of 1883–84, and a sum of £335 must be expended upon the laboratory at St Andrews, so that only a sum of £265 is left for other scientific work during 1884–85. No special grant for the scientific work of the Board having thus been made, the Board has unfortunately been compelled to suspend the investigations which it had instituted on the West Coast. Statement of what money has been received and what is further required. No special grant made.

From the statements made above in Section C, it will be seen that the principal investigations in which the Board has hitherto engaged are as follow:—

1. The examination of the more important spawning beds of the herring in the Moray Firth, and experiments as to the best method of artificially fertilising and hatching herring eggs. Work in which Board has been engaged.

2. The collection of material all round the Scottish coast, by means of the fishery officers, for determining the food of the herring throughout the year.

3. The investigation of the percentage of immature herring taken as sprats on the east coast during the winter fishing.

4. The study of the process of spawning of the herring, and the nature of the Ballantrae spawning ground.

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Work Board proposes to prosecute.

The principal lines of inquiry on which the Board proposes to engage in future are the following:—

1. The examination of all the spawning beds around the Scottish coast, with the view of increasing the fishing, more especially on the west coast.

2. The further collection of material for determining the nature of the food of the useful fishes met with on the Scottish coast.

3. The further investigation of the percentage of immature herring and other food fishes destroyed under present methods of fishing.

4. The investigation of the influence of sea-birds, parasites, &c., on the supply of food fishes.

5. The study of development, rate of growth, and general life history of the herring and other economic fishes, and the further study of the spawning process, and the nature of the eggs of fish.

6. The determination of the best means of restocking deserted fishing grounds by artificial cultivation or otherwise of herring, cod, flat fish, &c.

7. The determination of the practicability of increasing the supply, by artificial means, of lobsters, mussels, oysters, and other shell-fish.

8. The inquiry as to the influence of fungi and other minute organisms in destroying the life of useful fishes, and the conditions which predispose to the attacks of these organisms.

How Board proposes spending £1000 asked for.

In order to prosecute these investigations, the Board estimates that (in addition to the money already transferred from the surplus Herring Brand Fund) at the very least the sum of £1000 will be required during the year 1884–85. The particulars of the required expenditure may be estimated as follow:—

1. For the examination of the spawning beds, and for studying the habits and life history of the herring and other food fishes, &c.	£300
2. For collecting material for determining the nature of the food of fishes, ...	200
3. For inquiring as to the destruction of immature fish, and as to the influence of fungi, parasites, and other enemies, ...	100
4. For the employment of skilled assistants, . . .	250
5. For travelling and petty expenses, ...	50
6. For appliances, ...	100

Special vote should be granted without delay.

The Board desires to express emphatically the desirability of continuing without further interruption the researches which have meanwhile been suspended, and on this account strongly urges that not less than the above sum of £1000 should be placed at its disposal with as little delay as possible.

Additional grant for Laboratories.

In addition to this grant, the Board feels that it is very desirable that another grant be voted to provide a small laboratory on the west coast, near the Ballantrae fishing bank, and also one on the east coast. The Board has ascertained that the lowest estimate for carrying out these objects would be £1200.

Sailing cruiser should be superseded by a steam vessel.

Further, it has been found that the sailing cruiser belonging to the Board, owing to the introduction of steam fishing boats, is in many respects inadequate for the ordinary work of superintending

the fisheries. If this cruiser * were superseded by a steam vessel of a somewhat larger size, and the present superintending gunboat H.M.S. 'Jackal' replaced by a seaworthy boat adapted for the work of a fishery cruiser, and each boat provided with a suitable tender, not only would the ordinary work of the Board be more efficiently performed, but the scientific researches would be immensely facilitated.

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'Jackal' replaced by a seaworthy boat.

Tenders should be provided.

When the various appliances have been provided, it is estimated that the work mapped out above would extend over a period of three or four years, and necessitate an annual expenditure of about £1500.

£1500 required for three or four years.

Finally, the Board desires to point out that all the sums now applied for are, even in their aggregate, extremely small if compared with sums devoted to similar purposes by the Governments of the United States, Canada, Germany, and other nationalities, and that the investigation of the habits, &c., of our food fishes is not a local, or even a Scottish question, but one which is of imperial importance. Sooner or later the work must be done by the State, and as the great feeding grounds of the herring and other useful fishes lie off the Scottish coast, the carrying out of this work will be most economically performed by the Fishery Board for Scotland.

Sums asked for extremely small.

Work can be best done by Board.

The United States engages between twenty and thirty skilled naturalists, and has one splendidly equipped marine laboratory, and in addition several hatching establishments, each with a competent staff of assistants. A large steam vessel has been specially built, at a cost of above £60,000, for making observations along the coasts, and a smaller steam vessel, adapted for hatching and other operations, has been in use for some years. During 1882–83, it is understood that upwards of £40,000 was placed at the disposal of the United States Fishery Commissioner, in addition to which about £24,000 was expended by the Commissioners of 39 States.

United States has most complete arrangements for carrying on work, and votes large sums annually.

Further, the United States Commissioner of Fisheries obtains whatever assistance he requires from the navy, and from the telegraph, engineer, and other State Departments.

The Board, however, confidently anticipates that, with the assistance of the comparatively small sums now applied for, it will be able to conduct scientific investigations yielding results fully comparable to those which are being obtained by other Governments.

This anticipation is grounded on the following facts:—

Reasons for believing important results will be obtained without great outlay.

1. That the Board is already an institution with a large staff of intelligent officers stationed at various parts of the coast capable of making observations, and of collecting material, &c.

2. That Professor Stirling, D.Sc., of Aberdeen; Professor M'Intosh, F.R.S., of St Andrews, and other distinguished naturalists, are prepared to assist gratuitously the Board in conducting its investigations.

3. That the scientific members of the Board itself are likewise prepared to devote a large portion of their time to the same object.

4. That the exertions of the Board have already yielded results of the highest promise.

The Board desires to express its thanks to Professor Stirling, D.Sc., Professor M'Intosh, F.R.S., Mr Duncan Matthews, Miss Maclagan, and Dr Francis Day for their valuable additions to the Report included in Appendix F.

* See also under 'Marine Police,' p. lviii.

TELEGRAPHIC EXTENSION.

Telegraphic Extension to remote Fishery Districts.

In continuation of the proceedings narrated in our Annual Report for last year, regarding telegraphic extension to remote fishery districts, we have now to report that the Lords of the Treasury, as recommended by the Select Committee of the House of Commons upon the Herring Brand in 1881, were pleased to authorise that £1000 from the surplus herring brand fees of 1883 be applied towards this purpose, making, with a like sum transferred from the brand fees of 1882, £2000 altogether. As this amount, however, was insufficient to enable us to give the guarantees required by the Postmaster-General for extending telegraphic communication to the whole of the stations mentioned in our first Annual Report, even with the addition of such contributions from the respective localities as we could hope to obtain, we were under the necessity of restricting the selection which we then made to the following places, viz., Castle Bay, island of Barra; St Mary's, Burra, and St Margaret's Hope, Orkney; and Reawick and Vaila Sound (Walls), Shetland. The guarantees required for the extension to these places for each of the next seven years are as follow:—Castle Bay, Barra, £1095; St Mary's, Burra, and St Margaret's Hope, Orkney, £298; Reawick and Vaila Sound (Walls), Shetland, £281.

£2000 applicable thereto.

Restriction of Stations selected.

Guarantees required by Postmaster-General.

With the view of inducing the parties interested in the several localities to assist us in having the works carried out, we resolved, subject to the approval of the Lords of the Treasury, to give the guarantees required by the Postmaster-General, provided these parties relieved us of one-third of the amount thereof. The sum required for Castle Bay, however, was so large that we were unable to get such an arrangement carried out in so far as it was concerned; but upon a strong representation being made to the Lords of the Treasury by an influential deputation representing persons engaged in the fishing industry for assistance, their Lordships were pleased to make a special grant of £500 to the Board in respect thereof, to extend over two or perhaps three years. This removed the difficulty, and we are gratified to be able to state that arrangements are now in course of being completed for extensions to the several places named above being carried out.

Difficulty regarding Castle Bay.

Special Grant of £500.

Arrangements in course of completion.

HARBOURS.

Want of Harbour Accommodation.

In our First Annual Report we informed you that our attention had been prominently directed to the great want of suitable harbour accommodation for fishing boats which existed on the sea coasts of Scotland, especially on the east coast, and we fully stated the views which we held on the subject of increased harbour accommodation being provided. We likewise expressed the hope that, looking at the great and increasing value of the fisheries of Scotland, and that towards their full development it is absolutely necessary that many existing harbours should be enlarged and deepened, and others erected in suitable places, the funds placed at our disposal to assist in carrying out these objects would be greatly increased. We beg now respectfully to endorse what we then said.

More Money required.

Improvement of old Harbours and Construc-

With reference to the fishery harbours which should be improved, and the places where new ones ought to be constructed, we felt, when reporting to you on 24th May 1883, that this subject

could not be satisfactorily treated without a detailed inquiry such as there had not been opportunity of making since the Board was constituted; and we had intended to institute such an investigation, on being authorised by the Lords Commissioners of Her Majesty's Treasury to incur any necessary expense connected therewith. Since that time, however, a select Committee of the House of Commons has been engaged in inquiring into the harbour accommodation on the coasts of the United Kingdom, having regard to the laws and arrangements under which the construction and improvement of harbours may now be effected, and it has therefore seemed to us undesirable, at least for the present, that the investigation we had proposed to make should be prosecuted. At the same time, we think it right to bring under your notice the fact that pressing applications have been made to us to assist in the construction or improvement of fishery harbours at the following places, viz.:—

Harbours. — Construction of new ones. Detailed Inquiry necessary. Delayed, as Parliamentary Committee had been appointed.

Applications made regarding Harbours.

1. Findochty,	Banffshire.	13. Eyemouth,	Berwickshire.
2. Ness,	Island of Lewis.	14. Waternish,	Island of Skye.
3. Crovie,	Banffshire.	15. Broadford,	Island of Skye.
4. Port Errol,	Aberdeenshire.	16. Lochbuy,	Island of Mull.
5. Fair Isle,	Shetland.	17. Coldingham,	Berwickshire.
6. St Andrews,	Fifeshire.	18. Ballantrae,	Ayrshire.
7. Kinlochbervie,	Sutherlandshire.	19. Port Hopeman,	Elginshire.
8. Balintore,	Ross-shire.	20. Burnmouth,	Berwickshire
9. Stonehaven,	Kincardineshire.	21. Girvan,	Ayrshire.
10. Scoraig,	Ross-shire.	22. St Monance,	Fifeshire.
11. Portknockie,	Banffshire.	23. Foula Island,	Shetland.
12. Stroma Island,	Pentland Firth.		

Harbours for which Money has been asked.

Of these Harbours, looking at the limited funds placed at our disposal, we selected and have only seen our way to give assistance in the cases of

Harbours assisted.

Findochty,	Banffshire.
Ness,	Island of Lewis.
Crovie,	Banffshire.
St Monance,	Fifeshire.

But some of the others are very clamant cases, and it would have been a matter of the greatest satisfaction to us had we been in a position to aid them also.

For particulars regarding the harbour works in progress under our supervision, we beg to refer to the Engineers' Report in Appendix E, in which Appendix will also be found an account of the amounts we received and paid last year for building and repairing piers and harbours, together with a statement of the sums received, ex herring brand fees, for harbours, and telegraphic extension to remote fishery districts.

Reference to Engineers' Report.

As stated in the Engineers' Report, the construction of a harbour at Ness, in the island of Lewis, which is fully more than half built, continues to be vigorously prosecuted; and it is anticipated that, should the present season prove favourable, it will be finished in the course of this year. The fishermen are looking forward with great interest to the completion of this harbour, and have frequently expressed much gratitude for what is being done. Hitherto, when the boats arrived from the fishing grounds, in order to land their fish, they had to be hauled up on the beach with the assistance of

Ness Harbour

Harbours.

the people from the village, who had to go into the water for the purpose. The gross cost of the harbour will be about £6000. Of this sum £1500 has been contributed by the trustees of the late Sir James Matheson, Bart., and the remainder is being paid by us. The harbour will be about an acre in extent, and it will largely tend towards the development of the fishery in that part of Lewis. It may also be mentioned that the works have been so designed as to be capable of extension at any future time.

Findochty Harbour.

The works originally contracted for at Findochty harbour, Banffshire, were begun by the old Fishery Board, and they are now finished. They consist of a pier about 540 feet in length, on the western side of the creek, and the excavation of the interior of the harbour to the level of low water of spring tides. The only work now in progress is a short breakwater for the protection of the harbour. This breakwater has been contracted for, and has now been extended to about half its full length. The new harbour is highly appreciated by the fishermen, and will afford accommodation and shelter for a large number of boats.

Crovie Landing Slip.

In regard to the landing slip at Crovie, reported on by the engineers, this station lies about one mile east of Gardenstown and seven miles east of Banff. There is an entire want of harbour accommodation at the place, and there are no natural facilities whatever for the construction of a harbour, where the fishing boats could be kept in safety during bad weather. About sixty boats belong to the fishermen residing in the village, but only about twenty of them, of the smallest class, are able to prosecute the fishing from the station, the others having to leave and fish from other places. The small boats carry on the haddock fishing during eight months of the year, and have to be hauled up every night after discharging their fish, their ballast requiring on each occasion to be thrown out and taken on board again before proceeding to sea. There is a small inlet in the high ground at the top of the sea beach, at the mouth of a burn, where the hauling-up process is accomplished; and what the fishermen desired was to have constructed at this place, a landing slip running obliquely across the beach, and a part of the beach smoothed in order to facilitate the process:—the direction of this slip to be such that the waves would fall on the outerside of it, and so give a certain amount of protection in moderate on-shore winds. The engineers reported that the construction of the proposed slip, and the carrying out what was otherwise suggested, would be of very great advantage to the fishermen. It was estimated that the cost of the whole works, inclusive of engineers' fees, &c., would not exceed £1200; and having given the matter our best consideration, we resolved to order them to be carried out, on condition that the fishermen would contribute £300 towards the expense. This condition having been complied with, the works were begun, and will be finished this season.

St Monance Harbour.

The fishermen of St Monance, to their great credit, unaided by any public grant, erected a good harbour there, at a cost of about £15,000. The increased size of the boats now engaged in the fisheries rendered it absolutely necessary that some rock should be excavated, and the outer entrance channel to the harbour widened, but the fishermen were quite unable to raise the amount

required for these additional works. After having made full inquiry into the whole circumstances of the case, we resolved that, in the event of the fishermen paying us £500, we would expend an amount not exceeding £2000 in all towards carrying out what was required. This £500 was sent to us, and we had the gratification of ordering the works to be proceeded with. Harbours.

HERRING FISHERY.

The herring fishery of the year 1883 was exceeded only by the productive fishings of 1880 and 1882. The totals of the fishings of each of these three years are :— Herring Fishery.

Year.	Barrels cured.
1880,	1,473,600¼
1882,	1,282,973½
1883,	1,269,412½

Barrels cured in 1880, 1882, and 1883.

These results show that the fishing of 1883, as compared with that of 1882, was only deficient by 13,561 barrels, or little more than one per cent. This deficiency was wholly caused by a decrease in the fishing on the west coast of 83,240½ barrels. On the east coast there was an increase of 69,679¼ barrels, by which the deficiency on the gross fishing of the year was reduced to 13,561 barrels, as stated above. Barrels one per cent. less in 1883 than in 1882. Caused by falling off on West Coast.

The particulars of the results of the fishing of last year, when compared with those of 1882, in the herrings cured, branded, and exported, and in the amount of brand fees received, are as follow :— Results of 1882 and 1883 compared.

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees.
1882, . .	1,282,973½	462,612½	825,982¾	£7710 4 2
1883, . .	1,269,412½	470,995½	890,760½	7849 18 6
Increase in 1883,	...	8,383	64,777¾	£139 14 4
Decrease in 1883,	13,561	...	...	...

A comparison of the results of 1883 with the average of those of the preceding ten years, shows a considerable increase in all the items, viz. :— Increase of 1883 on average of preceding ten years.

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees.
Average of ten years, 1873-1882, .	994,398	457,251	678,530	£7620 17 0
Year 1883, . .	1,269,412½	470,995½	890,760½	7849 18 6
Increase in 1883, .	275,014½	13,744½	212,230½	£229 1 6

WEATHER.

Weather not favourable for Fishing.

During last year the fishermen experienced rather more than the usual interruptions by unfavourable weather. Long periods of calms, with occasional storms intervening, formed the general features of the most important period of the season, at which time large shoals of fish were upon the coast. This was particularly the case in regard to the stations of Eyemouth, Montrose, Moray Firth, Lewis, and Barra. There were, however, comparatively few sudden and violent gales, and happily the loss of life at sea and damage to property was not so great as in some preceding years; nevertheless, 82 fishermen were drowned while prosecuting their calling—65 on the east coast, and 17 on the west coast. The quantity of property destroyed was about the average of previous seasons. The fishing being now mainly prosecuted at a great distance from land, entailing long voyages out and home, the state of the weather has become of much more importance than was formerly the case, when the herring shoals were chiefly found inshore.

82 Fishermen drowned.

Property destroyed.

Long Voyages out and Home.

EAST COAST HERRING FISHERY.

East Coast Herring Fishery.

Following the course adopted by us last year, we shall now give some details, taken from the Reports of the inspectors and district fishery officers, regarding the herring fishery of 1883 in each of the twenty-six districts into which the coasts of Scotland are divided, beginning with the seventeen on the east coast. These are:—Eyemouth, Leith, Anstruther, Montrose, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, Wick, Orkney Isles, and Shetland Isles.

East Coast Districts.

Eyemouth District.

In Eyemouth district the average number of boats employed was 432. The fishing commenced with a small fleet early in June, but the takes were very limited till the beginning of August, when the weekly average catch was about 12 crans per boat. Unfavourable weather then set in, and for some time the fishermen were detained in harbour two or three nights a week. On 18th August an Eyemouth boat landed a take of 121 crans, which realised £253. The best week of the season was that ended 25th August, which yielded the high average of 59 crans per boat. The herrings were got close inshore, and were of good quality; and it was observed that a large shoal which had yielded the most productive fishing left the coast about the end of August immediately after spawning. Thereafter, the fishing was continued, but with very partial success, till the middle of September, when it closed with a gross average catch of 121 crans for each of the 432 boats which had on an average been engaged, against 157 crans in 1882 for 381 boats. During a part of the season the fishermen at Eyemouth had 11 steam tugs employed in towing their boats at a weekly cost of £500. The services of these tugs were of great value, more particularly in the best week of the fishing, the weather at that time having been calm.

Takes limited in June and July.

Abundant Fishing in August.

Large Shoal left after Spawning.

Average catch of Season.

Steam Tugs Towed Boats.

East Coast Herring Fishery.

Leith District.

In Leith district the summer fishing of 1883 was carried on chiefly at Dunbar station, but herrings were frequently landed at Newhaven from other stations. The average number of boats which fished at Dunbar was 32, against 45 in 1882. The fishing began early in July and ended in the first week of September. A few good takes were got in Skateraw and Cove bays, but the ground principally fished was from 20 to 30 miles off shore. The average catch for the season was 82 crans per boat. In 1882 it was 60 crans.

Number of Boats.

Fishing Grounds.

Average Catch of Season.

Anstruther District.

Boats nearly all left for other Stations.

Although Anstruther district has a large fleet of the finest boats in Scotland, only 15 remained to fish at home in 1883, the rest having gone to Shetland and other northern stations. The fishing began about the middle of July, and closed at the end of August. The catch of the 15 boats engaged was 750 crans, being an average of 50 crans to each. It was nearly all got about 20 miles east of the Island of May, and the greater part was sold fresh, or cured ungutted. About the same quantity of herrings was landed at Anstruther by boats from Aberdeen and other places, driven by stress of weather to take shelter there.

Herrings got east of Island of May.

Boats came for shelter.

Montrose District.

Average catch of Season.

Weather Unfavourable.

In 1883, 174 boats were engaged in Montrose district, being an increase of 8 on the former year. The fishing began in the second week of July, and closed in the first week of September, with an average catch of only 88 crans per boat. In 1882 the average was 173 crans. Most of the herrings were caught 20 to 70 miles at sea, but owing to unfavourable weather the boats were only able to make about two trips a week to the fishing grounds. In the week ended 11th August there was appearance of large shoals of herring upon the coast. Unfortunately, however, stormy weather kept the boats in harbour the greater part of that time. The week ended 25th August was the most productive of the season. The ground then fished was from 5 to 16 miles offshore, and the takes got were from 40 to 95 crans per boat.

Takes got in best week.

Stonehaven district.

Unfavourable Weather retarded Fishery

In Stonehaven district 110 boats were employed last year, being 9 more than in 1882. The fishing began in the second week of July and was continued for seven weeks; but, owing to alternate calms and gales of wind, it was very irregularly prosecuted. The average number of crans landed per boat for each week of the season was 16, 13, 12, 12, 12, 45, and 5, respectively. On the second last week, which ended 25th August, some boats got takes of from 60 to 106 crans, on ground from 5 to 24 miles off shore. The average catch for the year was 120 crans per boat. In 1882 it was 157 crans. It was believed regarding this district, as well as of Montrose, that the boats had gone too far seaward during the greater part of the season, and had thereby missed large shoals of herring lying nearer land.

Average catch of Season.

Boats went too far Seaward.

Districts of Aberdeenshire.

2056 Boats Fished.

The Aberdeenshire coast still yields the largest herring fishing in Scotland, and it possesses the three excellent harbours of Aberdeen, Peterhead, and Fraserburgh. The aggregate number of boats which fished in 1883, in the three districts where these

East Coast Herring Fishery.

Fishermen attracted to Shetland.

Storms and Calms interrupted Fishing.

Heavy Catches unprecedented.

Netting lost by weight of Fish.

Steam Tugs.

Steam Fishing Boats.

Curing Vessels.

Herrings Cured at Sea Branded.

harbours are, was 2056, being 148 less than in 1882. This decrease was owing to some of the most enterprising curers and fishermen having been attracted to Shetland by the unprecedented prosperity of the herring fishery there. The fishing commenced on the Aberdeenshire coast in the beginning of July, and ended about the first week of September. It was prosecuted with much energy and perseverance; but in the eight weeks, when it was general, there were storms and occasional calms, which kept the boats in harbour fully one-third of the fishing nights. The most productive week in Aberdeen district was that ending 25th August, when the average catch per boat was 26 crans, but there were takes of from 80 to 97 crans. The same week was also the heaviest in Peterhead district, and the number of heavy catches there was quite unprecedented. Takes of 90 to 120 crans were common, and the week's fishing gave the high average of 50 crans per boat. Unfortunately, however, there was a great loss of netting, which had been sunk by the weight of the herrings caught. In Fraserburgh district takes of 80 to 90 crans were got in July, but the best week of the season was that ending 18th August, when the average catch per boat was about 23 crans. Steam-tugs were extensively employed at the three stations, and rendered valuable assistance in towing the boats during calm weather. There were 3 steam fishing boats engaged at Aberdeen, but although well furnished with all the necessary equipments, their catch was under the average of the fleet. At Peterhead there were 2 vessels employed which had been fitted out for the deep-sea fishing with nets, barrels, and salt, and they were fairly successful. The herrings which they caught were cured at sea, a system which has been in abeyance on the east coast for many years, and a portion of them having been cured in conformity with the requirements of the Fishery Acts and regulations, was found entitled to the official brand.

Results.

The season closed with the following results for the three districts:—

Aberdeen District.

Aberdeen had an average catch of 89 crans per boat, and a total of 51,828 barrels cured, being a decrease, when compared with 1882, of 77 crans on the average, and of 59,143 in the number of barrels.

Peterhead District.

Peterhead had an average of 155 crans per boat, and a total of 182,590 barrels cured, showing an increase on the previous year of 4 crans on the average, but a decrease of 3114 on the barrels.

Fraserburgh District.

Fraserburgh had an average of 138 crans per boat, and a total of 192,827½ barrels cured, being 17 crans on the average and 40,470 barrels respectively less than in the preceding year.

Banff District.

In Banff district 182 boats were engaged in 1883, being the same number as in 1882. The fishing began in the second week of July, and closed in the first week of September, but it was occasionally interrupted by calms and contrary winds.

Average Catch.

The average catch of the year was 117 crans per boat, against 137 in 1882. The most successful week was that ending 4th August, when the fleet averaged 27 crans per boat.

East Coast Herring Fishery.

In the Moray Firth districts, which embrace Buckie, Findhorn, Cromarty, and Helmsdale, the aggregate number of boats employed in the herring fishery last year was 312, being 98 less than in 1882. The average catch for each boat was 68 crans, showing an increase on 1882 of 17½ crans. The average for each of these districts was 120, 58, 39, and 55 crans respectively. A considerable proportion of the catch was got 50 to 70 miles at sea, but the most successful fishing was made inshore. In the week ending 4th August good takes were got on the rich beds off Tarbetness, and the average for that week was 26 crans per boat. In the same week Buckie Bay yielded the high average of 50 crans per boat, and in the week ending 25th August fishing was got in Portgordon Bay, which produced an average of 26 crans. Not a few of the boats which fish herrings from the upper reaches of the Moray Firth are old and inferior, and do not venture much to sea during the stormy weather, which generally prevails to a greater or less extent every season about the latter part of August.

Buckie, Findhorn, Cromarty, and Helmsdale Districts.

Average Fishing per Boat.

Offshore and inshore Fishing.

Averages of Buckie and Portgordon Bays.

Old and inferior Boats.

Lybster District.

In Lybster district 138 boats were employed in 1883, or 19 fewer than in 1882. The fishing began about the middle of July, and lasted till the first week of September. The average catch for the season was 111 crans per boat, being the highest in this district for the last thirty years, and presents a remarkable contrast to the fishing of 1882, which was almost an entire failure. The herrings were caught chiefly on ground lying from 200 yards to 3 miles from the land; and the most successful weeks were those ending 18th and 25th August, each of which yielded an average of 28 crans per boat.

Best Fishing for thirty years.

Fishing chiefly inshore.

Wick District.

Wick district had 518 boats engaged in 1883, being 82 less than in the previous year. The season was begun by a few boats in June, but little success was got till the second week of July, when the number of boats increased. Thereafter the fishing proved very abundant. In July, weekly averages of 30 to 60 crans per boat were caught, which were the largest Wick had ever known in that month. This success was continued and increased in August, when large shoals of herrings were found both near the land and far out at sea. During the last ten days of that month the fishing was most productive within 4 miles of the shore. Takes of 80 to 118 crans were landed, and the average for the two weeks ended 25th August was 98 crans per boat. The season closed about 1st September, and yielded the largest returns which the district had ever experienced. The average catch of the year amounted to 232 crans per boat, being exactly double that of 1882.

Fishing very successful.

Heavy takes inshore.

Largest returns ever known.

Orkney District.

Orkney district had a fleet of 205 boats in 1883, showing an increase of eight boats on the number in 1882. The general fishing commenced in the beginning of July, with a fair amount of success. The last week of that month gave an average catch of 45 crans per boat, by which time several boats had fished their complement of 200 crans, while a few had landed upwards of 300 crans. Owing chiefly to unsuitable weather little was afterwards done till the week ended 25th August, when an immense shoal of herrings

Successful Fishing in July.

East Coast Herring Fishery.

Immense Shoal at Stronsay.

Very heavy Fishing.

Many Nets lost.

Highest average Catch on record.

New Curing Stations.

was discovered at Stronsay close inshore. On the 22nd and 23rd of that month the boats got the great average of 50 and 38 crans, respectively. One boat landed a take of 130 crans, and by this time another boat had fished altogether no fewer than 760 crans, while several others had caught upwards of 500 crans. Unfortunately many nets were sunk and lost by the great weight of fish which they had taken. The season closed during the week ending 1st September with an average catch of 181 crans per boat, being the highest ever recorded in Orkney district, and more than double that of 1882. In consequence of the remarkable success of the fishing in this district last year, arrangements have been made for the erection of additional curing premises; and it is anticipated that this year there will be a considerable increase in the fleet engaged in the industry.

Shetland District.

Erection of additional Premises.

Increase of Boats and Fishcurers.

Number of Persons employed.

Good order maintained.

Division of District.

Lerwick Section.

Increase of Decked Boats.

Successful Fishing on West Side.

Average of best week.

Unst Section.

Successful Fishing in June.

Unsettled Weather and Dog-fish.

In Shetland district the extraordinary success of the herring fishing of 1882 caused preparations on a greatly extended scale to be made for 1883, and in Lerwick especially and neighbourhood, and at Balta Sound in Unst, a considerable amount of capital was expended in erecting additional curing stations. In 1882 the number of boats engaged in the fishing was 372, whereas in 1883 no less than 792 were employed. This large fleet included boats from the Firth of Forth, Aberdeenshire, Moray Firth, Caithness, Ross-shire, Argyllshire, England, Ireland, and the Isle of Man. The number of curers in 1882 was 21; in 1883 it rose to 67; and it was estimated that the number of fishermen and persons employed in curing last year was 5389. It is satisfactory to observe that, notwithstanding, good order was maintained throughout the season. This was very much due to an increase in the constabulary force, and occasional visits of H.M.S. 'Firm.' For its more efficient supervision, and for better meeting the demands for branding, Shetland district was divided into two sections—Lerwick and Unst.

In Lerwick section 466 boats were employed in 1883, and in Unst section 326—making together, as stated above, 792 boats, of which 710 were decked, and 82 were small boats. As compared with 1882 this shows an increase of 444 decked boats, a decrease of 24 small boats, and an increase in the total number of boats of no less than 420. The fishing was begun in Lerwick section in June, during which month it was prosecuted on the west side of Shetland with 305 boats, and for that month it yielded an average of 60 crans per boat, being double the produce of the corresponding period in 1882. Thereafter, it was continued with more or less interruptions caused by unfavourable weather, until about the middle of September, when it closed. The best week of the season was the one ending 25th August, which gave an average catch of 47 crans per boat.

In Unst section a few inferior herrings were caught in May, but the regular fishing did not begin till June. At the end of that month the boats were very successful, and some of them got takes of 80 and 90 crans. From the beginning of July till about the middle of September, when it closed, the fishing was irregularly prosecuted owing to unsettled weather and shoals of dog-fish appearing on the coast. The boats averaged during that time from 15 to 30 crans a week.

East Coast Herring Fishery.

Shetland District.

Produce of Season.

Unparalleled success.

New Fishing Ground.

New Curing Stations.

Effect of successful Fishing.

The gross fishing in 1883 of the 792 boats in Shetland district gave an average catch of 242 crans to each, being the highest average of all the east coast districts. It produced 256,487 barrels of cured herrings, or nearly double the number yielded by the successful season of 1882, and more than four times that of 1834, which was the largest ever before known in Shetland. In all probability this success may be still further increased, new fishing ground having been discovered north of Unst, where herrings have been caught of superior size and quality. In view of this it is understood that sites for curing premises have been taken at contiguous places in North Yell. Arrangements have been made for the erection of additional stations in various other parts of the district. As illustrative of the beneficial effects which the recent development of the herring fishery in Shetland has had upon the native population, it may be stated that in 1877 they only possessed 3 decked boats, while in 1883 that number had increased to 240, and is still becoming larger.

Summary of East Coast Herring Fishery.

Summary of East Coast Herring Fishery.

Increase of 69,679¼ Barrels in 1883.

Development of Fishery in Shetland.

Barrels Cured in 1881, 1882 and 1883.

Herring Fleet.

The returns of the herring fishery on the east coast for 1883 exhibit an increase in six districts over those of 1882, amounting to 228,487 barrels cured, and a decrease in eleven districts of 158,807¾ barrels, resulting in a net increase of 69,679¼ barrels in 1883. The increase was altogether made up in the districts of Shetland and Orkney, in the districts on the north coast of the Moray Firth, and in Buckie district. In all the other east coast districts there was a greater or less falling off. It may be here remarked that the most striking feature recently connected with the herring fishery of Scotland is its rapid development and great increase in the Shetland Islands. Regarding this fishery the inspector of the former Board reported in 1874 that it 'has become of so small 'mark as scarcely to call for notice.' In that year the fishing throughout the whole of these islands yielded only a total of 1100 barrels. In 1881 the catch amounted to 59,586 barrels, in 1882 to 134,187, while in 1883 it reached 256,487 barrels. This catch of last year was equal to nearly a fourth of all the herrings taken on the east coast. The number of boats has increased in a corresponding degree. In 1874 the whole herring fleet fishing in the Shetland waters numbered 50 boats, in 1881 it rose to 276 boats, in 1882 to 372; and in 1883 it reached the large total of 792 boats.

East Coast Fishery of last fifty Years.

Yearly average Increase in periods of Ten Years.

The official returns of herrings cured on the whole of the east coast for the last 50 years, on the average of each period of 10 years, show a large and continuous increase. They are as follow:—

Periods of ten years.	Yearly average of Barrels cured.
1834 to 1843 inclusive.	409,957
1844 „ 1853 „	479,309
1854 „ 1863 „	523,013
1864 „ 1873 „	562,378
1874 „ 1883 „	843,743
Barrels cured in 1883,	1,047,905¾

East Coast Herring Fishing.

Increase per cent. on last Ten, Twenty-five, and Fifty Years.

The number of barrels cured in the year 1883, when compared with that of 1882, shows an increase of 7·1 per cent.; when compared with the average of the last ten years, it shows an increase of 23·9 per cent.; of 25 years, 57·3 per cent.; and of 50 years, 85·9 per cent.

WEST COAST HERRING FISHERY.

West Coast Herring Fishery.

West Coast Districts.

The nine fishery districts on the west of Scotland are:—Stornoway, Loch Broom, Loch Carron and Skye, Fort-William, Campbeltown, Inveraray, Greenock, and Ballantrae.

Stornoway District.

Fleet of Boats 1117.

The herring fishing was begun by a few boats at Stornoway about the end of April, but it did not become general till the middle of May. The fleet numbered 1117 boats, being 183 less than in the preceding year. 735 of these fished in Stornoway section, and 382 in Barra section.

Barra Section.

Fishing fairly successful.

Interrupted by stormy Weather.

It was owing to the partial failure of the fishing in 1882, that comparatively so few boats were engaged in the Barra section in 1883 against 609 in the previous year. Last season, however, was fairly successful, the average catch being 53¼ crans. In 1882 it scarcely reached 5 crans. The fishing began in the second week of May, and was continued till the end of June. It was principally prosecuted in the Atlantic Ocean from 15 to 20 miles west of Barra, but was greatly interrupted by stormy weather.

Stornoway Section. Length of Season.

Fishing fairly successful when Boats got to Sea.

Fishing grounds.

The fishing commenced in Stornoway section in May, and with the exception that a few small sized native boats continued at work until about 30th September, it closed towards the end of June. The weather was most unsuitable during the greater part of the season, and the boats were very frequently detained in harbour; but when they got to sea, the fishing was prosecuted with a fair amount of success. The shoals of herrings were chiefly found from 8 to 30 miles round the Butt of Lewis. In June catches were daily got in the Minch 10 to 25 miles from shore. At Carloway, where no fishing had been carried on for many years, 27 boats were engaged. There seemed to be plenty of herrings near this station, but it is much exposed to the Atlantic Ocean, and during the whole season the boats only ventured to sea eleven times.

Average Catch of Section.

Steamers and Tugs employed.

Their average catch per boat was 32½ crans. The average of the 735 boats which fished in Stornoway section was 48¾ crans, while in 1882 it was 62 crans. Several steamers and tugs were advantageously employed in carrying herrings, and in towing boats when required.

Stornoway District. Average Catch of 1117 Boats.

High price of Herring.

Barrels cured.

Stornoway district, embracing all the stations, shows for the 1117 boats engaged an average catch of 53¼ crans. In 1882, 1300 boats, which then fished, averaged 35 crans. During the season prices of fresh herrings were very high, reaching to 83s. per cran. The total number of barrels cured in 1883 was 68,387¼, against 52,231 in 1882, the great bulk of which was sent to the Continental markets.

14,000 Crans Kippered.

About 14,000 crans were kippered, being a considerable increase on the number in 1882.

West Coast Herring Fishery.

Loch Broom District.

In Loch Broom district last year 2474 barrels were cured, being an increase of 1348 on 1882. For some years past the fishing has not been productive in this district, and many of the native boats in consequence went elsewhere last year.

Loch Carron and Skye District.

Only 10,421 Barrels cured against 77,783 in 1882.

Loch Carron and Skye district, which, during the last few years, rose to be one of the most productive districts on the west coast, experienced a very great falling off during the whole of last season, the number of barrels cured being only 10,421, against 77,783 in 1882. In consequence of the heavy takes which had been got in Loch Hourn in the two previous years, great hopes were entertained that it would again afford a rich harvest. Fishing boats from many places congregated there in large numbers. Vessels came from other stations to buy the herrings which it was expected would be caught; steamers arrived to carry them away; and heavy expenses were otherwise incurred. Unfortunately, however, the anticipated success was not realised. The fishing was begun in July. It opened very badly, and notwithstanding the fact that all through the season it scarcely ever yielded any return, it was carried on till the end of December, in the hope that it would improve. All, however, was to no purpose: the season ended as badly as it had begun. Large shoals of herrings lying outside the loch, and beyond the other usual fishing ground, were observed by passing vessels and steamers, but they never came within reach of the fishermen. An unusually large quantity of mackerel appeared in Loch Hourn, and good takes were secured, but there was almost no market for them, and they had sometimes to be thrown back into the sea. It is understood that mackerel feed largely on young herring, and many fishermen believe that herrings will not remain on the same ground with mackerel, and that they never enter a sea loch where these fish are numerous. If this belief is well founded, the failure of the fishing in Loch Hourn last year may be fully accounted for.

Arrangements for Season.

Failure of Fishing in Loch Hourn.

Large Shoals at Sea.

Mackerel in Loch Hourn.

Mackerel supposed to keep Herring away.

Fort-William District.

Improved Fishing.

The fishing in Fort-William district was moderately successful, and again shows an improvement on that of the preceding year. The number of barrels cured was 9968½, being 4110½ more than in 1882. The stations which yielded the best returns were Loch Nevis and Loch Buy. Some boats from Loch Fyne began fishing in Loch Nevis with the seine-trawl net, but this, although a perfectly legal mode of fishing, was so strongly objected to by the native fishermen that they endeavoured forcibly to prevent its continuance, and serious disturbances arose in consequence, notwithstanding that H.M. cutter 'Daisy' was stationed there. It was therefore deemed necessary to instruct H.M.S. 'Jackal' to proceed to the loch. After her arrival, order was completely restored. It may be here mentioned that when the herring fishery is prosecuted with the seine-trawl net, two skiffs always work together, each having a crew of four men.

Fishing by Seine-Trawl Nets caused Disturbance.

'Jackal' sent to restore order.

How Seine-Trawl Net is used.

Inveraray District.

Length of Season.

In Inveraray district fishing was prosecuted last year all over Lower Loch Fyne up to Loch Gair, and occasionally in Kilbrannan Sound. It became general in June, and was continued with little in-

West Coast Herring Fishery.

Seine-Trawl and Drift Nets. Most successful Fishing. Barrels Cured.

Steamers employed.

Great Takes.

terruption till the middle of December. 261 boats were engaged in it, most of which were seine-net trawlers, and after the middle of the season drift-net fishing was all but given up. The year was a most successful one, and, with the exception of 1882, yielded a better return than had ever before been known in the district. 49,055 barrels were cured, and although this number was a large decrease on the preceding year, the fishing was believed to have been more remunerative, owing to the herrings being of superior quality and realising high prices. 12 steamers were constantly employed in carrying the fish away direct from the boats, and on some occasions that number was increased to 20. In July, August, and September scarcely a day passed without some great take being got by two of these seine-net trawlers, varying from 30 to 200 crans. Of these takes, one was understood to have been sold for £557, and another for £575.

Campbeltown District.

Fishing Second-best on Record.

Seine-Trawl Net.

Steamers took Herrings away.

Earnings of Boats.

The fishing in Campbeltown district in 1883 was also, with the exception of that of the previous year, the best it had ever experienced. It yielded 53,241 barrels of cured herrings, showing only a decrease of 4152 barrels on 1882. During the season, which was begun in April and continued till December, 431 boats were employed. Most of them used the seine-trawl net, and their success was much greater than those which had ordinary drift nets. Nearly the whole of the herrings were regularly taken away, without being landed, by 6 or 8 swift steamers for the home markets. There was always an excellent demand for them, and prices were obtained, varying from 40s. to 60s. a cran. It was estimated that the majority of the boats which used the seine-trawl net earned about £1000 each in the season.

Rothesay District.

The district of Rothesay in 1883 shows a great falling off in the fishing when compared with the former year, the number of barrels cured being only 3297 against 11,806 in 1882. A number of the boats, however, had gone to fish in other places.

Greenock District.

The returns from Greenock district show a decrease of 1635 in the number of barrels cured last year against that of 1882. The herring shoals never seemed to enter the Clyde, and the best equipped boats went to prosecute the industry elsewhere.

Ballantrae District.

Modes of Fishing.

High prices of Herring.

Winter Fishing worth £80,000.

The most important feature in Ballantrae district is its winter herring fishery, which is generally carried on during the months of January, February, and March. It is prosecuted in three different ways—by drift nets, seine-trawl nets, and trammel nets. In 1883 400 boats were engaged in it, and they had a successful season, which yielded about 24,575 crans. There was always an excellent demand for the herrings in the English markets, and prices as high as from £3 to £5 per cran were usually obtained. A considerable portion of the catch was kippered. Last year's winter fishing was estimated as worth the large sum of £80,000. The heaviest catch was made in the week ended 3rd March, when 16,060 crans were landed. Of these, 500 trucks containing 17,000 packages were despatched by railway from Girvan alone. Three

buying steamers were on the fishing ground off Ballantrae during the season; and it was stated that 3580 telegrams in connection with the industry passed through the Girvan post-office last year. The summer and autumn fishing of Ballantrae district is not of much importance, and the native fishermen during its continuance, as a rule, follow their calling at Kilbrannan Sound and on the coast of Argyle. Large quantities of mackerel were got in the district last autumn, but this fishery has not been prosecuted there with much energy.

West Coast Herring Fishery. — Buying Steamers. Telegraph Messages. Mackerel Fishing.

Summary of West Coast Herring Fishery.

The herring fishery on the west coast of Scotland produced in 1883 more than the average of recent years. The gross number of barrels cured was 221,506¾, but this is less by 83,240¼ barrels than the cure of the remarkably abundant year of 1882.

Summary of West Coast Fishery.

The returns from the different parts of the west coast exhibit the fluctuations that are constantly taking place in this fishery. Of the nine districts, four show a considerable increase on the previous year, and five a greater or less decrease, the falling off in two of the latter, Loch Carron and Skye, and Inveraray, being very large. Stornoway, Ballantrae, Fort-William, and Loch Broom districts yielded better returns than in 1882. The most productive stations were Kilbrannan Sound and Loch Fyne. These famous fishing centres, especially the latter, yielded almost daily during the season large supplies of those richly flavoured herrings which are so much prized in the home markets.

Fluctuations in Fishing. — Productiveness of Kilbrannan Sound and Loch Fyne.

As was the case some years ago, the herring shoals in 1883 never went much above Otter Ferry towards upper Loch Fyne. It was alleged that the cause of this was the presence of quantities of mackerel in the latter place, it being supposed, as has been stated in connection with Loch Hourn, that herrings never lie in waters where mackerel abound.

Presence of Mackerel supposed cause of failure in Upper Loch Fyne.

The official returns of all the herrings cured on the west coast for the last 50 years, on the average of each period of 10 years, exhibit a continuous and large increase. The following table shows the particulars:—

Periods of ten years.	Yearly average of Barrels cured.
1834 to 1843 inclusive	66,466
1844 „ 1853 „	79,529
1854 „ 1863 „	104,347
1864 „ 1873 „	172,089
1874 „ 1883 „	183,672
Barrels cured in 1883,	221,506¾.

Yearly average Increase in Periods of Ten Years.

Notwithstanding that the number of barrels cured on the west coast in 1883 was 27·3 per cent. less than in 1882, it will be seen from these returns that if that number is compared with the average of the last 10 years it exhibits an increase of 17 per cent.; if it is compared with the average of the last 25 years it shows an increase of 25·4 per cent.; and of 50 years 45·7 per cent.

Increase per cent. on last Ten, Twenty-five and Fifty Years.

SUMMARY OF HERRING FISHERY ON BOTH COASTS.

Summary of Fishery on both Coasts.

The following tabular statement gives the particulars of the increase or decrease in the herring fishery of 1883 in each of the twenty-six districts, as compared with that of 1882:—

The Twenty-six Districts.

Increase and Decrease of Barrels in 1883, as compared with 1882 in each District.

Fishery Districts.	Year 1882, Barrels cured.	Year 1883, Barrels cured.	Increase in 1883.	Decrease in 1883.
Eyemouth,	64,458	40,265	...	24,193
Leith,	2,475	2,154¼	...	320¾
Anstruther,	8,752	5,215	...	3,537
Montrose,	39,199	21,696½	...	17,502½
Stonehaven,	18,579	15,749	...	2,830
Aberdeen,	110,971	51,828	...	59,143
Peterhead,	185,704	182,590	...	3,114
Fraserburgh,	233,297½	192,827½	...	40,470
Banff,	31,261	25,872½	...	5,388½
Buckie,	13,518	15,530	2,012	...
Findhorn,	5,959	3,922	...	2,037
Cromarty,	1,645	1,373	...	272
Helmsdale,	7,994	11,018	3,024	...
Lybster,	3,458	19,338	15,880	...
Wick,	96,723	155,668	58,945	...
Orkney Isles,	20,046	46,372	26,326	...
Shetland Isles,	134,187	256,487	122,300	...
Stornoway,	52,231	68,387¼	16,156¼	...
Loch Broom,	1,126	2,474	1,348	...
Loch Carron and Skye,	77,783	10,421	...	67,362
Fort-William,	5,858	9,968½	4,110½	...
Campbeltown,	53,241	49,089	...	4,152
Inveraray,	85,352	49,055	...	36,297
Rothesay,	11,806	3,297	...	8,509
Greenock,	3,949	2,314	...	1,635
Ballantrae,	13,401	26,501	13,100	...
Totals,	1,282,973½	1,269,412½	263,201¾	276,762¾

Totals of Increase and Decrease.

Summary on both East and West Coasts during last Fifty Years.

While, however, these particulars show that the gross number of barrels cured in 1883 was less than in 1882 by 13,561 barrels, the official returns of cured herrings on both the east and west coasts for the last 50 years, on the average of each period of 10 years, exhibit a great and continuous increase. The following statement gives the particulars of this increase:—

Yearly Average Increase in Periods of Ten Years.

Periods of Ten Years.	Average Number of Barrels Cured Yearly in each Period.	Increase in Average Number of Barrels Cured Yearly in each Period.	Increase per cent. in Average Number of Barrels Cured Yearly in each Period.
1834 to 1843 inclusive,	476,424		
1844 ,, 1853 ,,	558,839¼	82,415¼	17·2
1854 ,, 1863 ,,	627,361	68,521¾	12·2
1864 ,, 1873 ,,	734,468	107,107	17
1874 ,, 1883 ,,	1,027,416½	292,948¼	39·8
Barrels cured in 1883,	1,269,412½.		

It is gratifying to see how the productiveness of the whole

herring fishery of Scotland has thus been becoming greater. The gross number of barrels cured in the year 1883, when compared with the average of the last 10 years, shows an increase of 23 per cent.; when compared with the average of the last 25 years it shows an increase of 34·5 per cent.; and of the last 50 years, 46 per cent. As a further illustration of the wonderfully great development of this fishery, we desire to point out that when the first returns were compiled by the former Fishery Board in 1809, the whole number of barrels cured was only 90,185½; whereas the number cured last year, as stated above, was 1,269,412½, or an increase of 1307·5 per cent.

Herring Fishery.

Increase per cent. on last Ten, Twenty-five and Fifty Years.

Great Development of Fishery since 1809.

QUALITY OF HERRINGS.

Speaking generally, the quality of the herrings caught on the whole coasts of Scotland last year was good. Those got in Campbeltown and Inveraray districts were remarkably fine, and fully as large as in any former season; but at some other places it was thought the size was smaller than in 1882.

Herrings generally of Good Quality.

HERRINGS CURED ON BOARD OF VESSELS AND ON SHORE.

Table I. Appendix A, shows the number of vessels fitted out in Scotland last year for the herring fishery; the districts from which they were fitted out, their tonnage and the number of men, the quantity of netting, salt and empty barrels shipped, and the total number of barrels of white herrings cured on board; distinguishing those cured gutted from those cured ungutted.

Vessels; and Herrings cured on Board.

Table II. Appendix A, shows the number of barrels of white herrings cured or salted in Scotland last year by fish-curers on shore, and the districts in which they were cured; distinguishing the herrings cured gutted from those cured ungutted.

Herrings cured on Shore.

Table III. Appendix A, shows the total number of barrels of white herrings cured or salted in Scotland last year, both on board of vessels and on shore, distinguishing the herrings cured gutted from those cured ungutted. To this table is added a supplementary note showing the number of barrels cured or salted last year on the west coast of Scotland, as stated by the districts where the herrings were caught.

Total of Herrings cured in Vessels and on Shore.

Herrings cured on West Coast.

BRANDING OF HERRINGS.

The quantity of herrings cured in 1883, and which, after examination by the Board's officers, was found entitled to the brand, amounted to 470,995½ barrels. This was an increase of 8,383 on the barrels branded in the previous year. The increase would have been much greater had it not been that in consequence of many of the boats being frequently detained at sea by calms and adverse winds, their herrings were so deteriorated in condition on being landed that they could not be properly cured. This state of matters, as indeed is the case more or less every season, called for

Branding of Herrings.

Increase on Barrels Branded.

Herrings not in good condition.

Herring Fishery.

Much care required by Fishery Officers.

much care and discrimination on the part of the fishery officers in granting the official brand, and we have every reason to be satisfied with the manner in which they carried out this important part of their work.

Particulars of Herrings Branded.

Table IV. Appendix A, shows the total number of barrels of white herrings which were branded in Scotland last year; of the brandings in each district, and the amount of fees collected. To this table there is added a note showing the total number of barrels therein given, which were branded 'Full,' 'Maties,' or 'Spent.'

Fraudulent Branding of Herrings.

Imitation of Crown Brand used.

Half Barrels less than statutory size.

Herrings of Inferior Quality.

Deputation waited on Board.

We regret having to report that a colourable imitation of the official Crown Brand was fraudulently used last year in branding half barrels of cured herrings. These half barrels were made of old staves, and of a smaller size than that fixed by the Act of Parliament and the regulations of the Board, and contained herrings of such inferior quality that they were quite unfit to be branded. Information regarding the fraud came to us from Stettin, the principal herring market on the Continent, from which place it appeared that such half barrels of herrings had been sent to the interior of Germany. Subsequently a deputation, representing herring merchants and fish-curers, waited upon us regarding the matter. They expressed themselves as much aggrieved that such an attempt should have been made to damage the legitimate trading upon the faith of the brand, and strongly urged that such steps should be taken as would lead to the exposure and punishment of the persons who had taken part in the fraud.

Importance of matter.

Brought under notice of Secretary of State.

Inquiry made.

Result.

Where Branding Irons were got.

We considered the matter of such great importance, not only as affecting the integrity and value of the brand, but also the interests of the fishing industry in Scotland, that we brought the whole circumstances of the case, in so far as they had been communicated to us, under your notice; and in compliance with a request which we made, you were good enough to get the Secretary of State for Foreign Affairs to make inquiry, through Her Britannic Majesty's Consul at Stettin, into the truth of the information we had received, with the view of legal proceedings being taken against any offending parties. The inquiry led to the discovery of the person,—a merchant in Stettin, who is believed to be chiefly responsible for the fraud, and proceedings have been instituted against him by the Procurator-Fiscal there, who is to bring him to trial. It is supposed that the irons which were used in branding the barrels were manufactured in Scotland, and every exertion is being made to discover by whom they were supplied.

HERRINGS EXPORTED.

Herrings Exported. Increased Quantity.

The total quantity of cured herrings exported last year amounted to 890,760½ barrels, being an increase on 1882 of 64,777¾ barrels; and it affords us much pleasure to state that, with the exception of the year 1880, which yielded the most abundant fishing ever known, this is the largest exportation of cured herrings on record.

From the following table it will be seen that Germany and other places on the Continent got 81,068¼ barrels more than in the previous year, but that Ireland got 14,507, and places out of Europe got 1783½ less respectively:— Herrings exported.

Barrels of Herrings exported.

Exports of 1882 and 1883 compared.

Years.	To Ireland.	To the Continent.	To Places out of Europe.	Total Exported.
1882, ...	40,377	782,576¼	3,029½	825,982¾
1883, ...	25,870	863,644½	1,246	890,760½
Increase in 1883, . .	...	81,068¼	...	64,777¾
Decrease in 1883, . . .	14,507	...	1,783½	...

Table V Appendix A. shows the total number of barrels of white herrings exported from Scotland last year; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and distinguising also herrings cured gutted from herrings cured ungutted, and herrings bung-packed from herrings repacked. To this table is appended a supplementary note showing the ports or places on the Continent to which the herrings were exported; and the total quantities exported. Particulars of Barrels Exported. Places to which Exported.

Table VII. Appendix A. gives an abstract of the total quantity of white herrings cured, branded, and exported, year by year, *in so far as brought under the cognizance of the fishery officers*, from 1st June 1809 to 31st December 1883; distinguishing the export to Ireland, to the Continent, and to places out of Europe. Yearly totals of Herrings, 1809–1883.

WINTER HERRING FISHERY.

The winter herring fishery is usually prosecuted in January, February, and March, but last season it was begun at the Leith and Anstruther stations in November. It is carried on to a greater or less extent in the districts of Wick, Lybster, Helmsdale, Cromarty, Findhorn, Montrose, Anstruther, and Leith on the east coast, and at Ballantrae on the west coast. The principal stations are Wick, Anstruther, Leith, and Ballantrae. Last season was a successful one, and produced far above the average of recent years. At Anstruther the catch reached 32,900 crans, being considerably more than double that of the preceding year, and 20,277 crans above the average of the last 25 years. The week ended 9th February yielded nearly as many crans as the whole of the preceding season. At the Leith stations the catch was greatly in excess of the former year, and higher than any one of the last eleven. At Ballantrae the fishing was much interrupted by westerly gales. It need hardly be stated that the success of the winter herring fishing greatly depends on the state of the weather. Winter Herring Fishery. Districts where prosecuted. Fishing last Season much above Average. Success greatly dependent on Weather.

Cod and Ling Fishery.

COD AND LING FISHERY.

Fairly successful.

Decrease in quantity cured.

Stormy weather restricted Fishing.

The cod and ling fishery of 1883 was fairly successful, although it shows a decrease as compared with the fishing of 1882 of 1,001¼ cwts. cured dried, and 427 barrels cured in pickle. Fish seemed to be abundant, and good supplies of herring bait were usually obtained; but the fishermen experienced very stormy weather throughout the whole winter and most of the spring, especially in the Stornoway district, which greatly restricted their operations.

Most productive Stations in Scotland.

Rich Fishing Grounds.

Herring Fishing more profitable than Cod and Ling.

Of the gross quantity cured at all the stations in Scotland, Orkney, Shetland, and Stornoway districts produced more than two-thirds. Shetland alone gave considerably more than one-third. In these districts this branch of the fishing industry is capable of being developed to a much greater extent than has recently been the case, as they lie contiguous to fishing grounds, where cod and ling are found in large quantities; but the remarkable success of the herring fishery during the last few years has resulted in the fishermen devoting themselves to its prosecution, to the comparative neglect of the other.

Fewer Vessels fitted out for Faroe and Rockall.

Last Year's Fishing not successful.

Only 9 vessels were fitted out for the Faroe and Rockall fishery, against 19 in 1882, while a few years ago the number was about 40. It is now a matter of difficulty to get crews to man these vessels. Last year's fishing was not successful, and present appearances indicate that this branch of the industry may soon be given up altogether, owing to the more profitable fishing which is to be found at home.

The total quantities of cod, ling, and hake cured and exported in 1882 and 1883 respectively, are—

Cod and Ling Cured and Exported in 1882 and 1883 compared.

Total Quantities of Cod, Ling, and Hake.

Years.	Cured. Dried.	Cured. In Pickle.	Exported all Cured Dried. To Ireland.	Exported all Cured Dried. To the Continent.	Exported all Cured Dried. To places out of Europe.	Exported all Cured Dried. Total.
	Cwts.	Barrels.	Cwts.	Cwts.	Cwts.	Cwts.
1882, ...	121,337	7,737	23,846	23,326	9,325	56,497
1883, ...	120,335¾	7,310	36,666½	17,123	2,736	56,525½
Increase in 1883, . .	...	...	12,820½	...	...	28½
Decrease in 1883, .	1,001¼	427	...	6,203	6,589	...

Increase in Exports to Ireland.

The increased exports to Ireland were owing to there having been a better demand in that country last year than in the Continental and foreign markets.

Cod and Ling cured on Board of Vessels.

Table I. Appendix B, shows the number of vessels fitted out in Scotland last year for the cod and ling fishery; the districts from which they were fitted out, the tonnage of the vessels, and the number of men; also the quantity of cod, ling, and hake cured on board.

Table II. Appendix B, shows the total quantity of cod, ling, and hake taken at the cod and ling fishery in Scotland last year by open boats, and cured on shore, distinguishing the fish cured dried and the fish cured in pickle; and distinguishing also the districts in which they were cured.

Cod and Ling Fishery.

Cod and Ling cured on Shore.

Table III. Appendix B, shows by districts the total quantity of cod, ling, and hake taken, both by vessels and by open boats, at the cod and ling fishery in Scotland last year, and cured; distinguishing the fish cured dried and the fish cured in pickle.

Total of Cod and Ling cured on Board of Vessels and on Shore.

Table IV. Appendix B, shows the total quantity of cod, ling, and hake exported from Scotland last year; the quantities thereof exported from different districts; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and also whether cured dried or cured in pickle.

Cod and Ling Exported.

Table V. Appendix B, gives an abstract of the total quantity of cod, ling, and hake cured, punched, or branded, and exported, year by year, *in so far as brought under the cognizance of the fishery officers*, from 10th October 1820, when the system for the encouragement and improvement of the cod and ling fishery commenced, to 31st December 1883.

Yearly Totals of Cod and Ling Cured and Exported, 1820–1883.

FISH SOLD FRESH.

The former Fishery Board regularly collected, through its fishery officers, statistics of the quantities of herring, cod, and ling which were *cured* in Scotland each year. We adopted the same course, and accordingly corresponding returns are inserted in our first Annual Report, which was laid before Parliament last year.

Former Board collected Statistics of Fish Cured.

The Act under which the present Board was constituted directs that our Annual Report shall contain 'a statistical account of the 'fisheries' of Scotland, thus requiring us to collect particulars of the quantity of white fish caught and sold *fresh*, as well as of those which are *cured*.

New Board also to collect Statistics of Fish sold Fresh.

Shortly after the Board was formed, we fully considered how this instruction could best be carried out, but we felt that the difficulties in the way of our being able to do so at all in a satisfactory manner were very considerable. The great extent of the coasts of Scotland, the limited number of officers in the employment of the Board, the insufficiency of funds at our disposal; and, even with funds, the want of statutory powers to enforce collection of the particulars required, made it at once evident that the returns which we would be able to obtain must to a certain extent be of an imperfect character. In endeavouring to carry out what was required, we directed the fishery officers in the 26 districts into which the coasts are divided to obtain as far as possible, by personal inquiry, and through correspondents to be appointed at the different harbours and creeks in their respective districts, statistics of all fish caught and which are not accounted for as cured in their present returns; and we gave them special instructions in what

Difficulties in doing this.

Plan adopted.

Fish sold Fresh.

way this was to be done, and provided them with printed forms in which the particulars were to be entered.

Communication from Board of Trade regarding Fishery Statistics.

We think it right to state that while engaged in this work, the Board of Trade sent us a communication regarding the collection of the Fishery Statistics of Great Britain and Ireland. In reply we furnished that Board with detailed particulars of the manner in which we were carrying on the work above referred to, and expressed our opinion as to various matters in connection therewith about which they consulted us.

Year for which returned.

Owing to the recent constitution of the Board, our arrangements could not be completed in sufficient time to enable us to have the work begun until April 1st of last year, and we have therefore thought it desirable to give the statistics in this Report for twelve months beginning at that date. In future, however, we propose making up the return for each year ending 31st December. As we anticipated, our officers experienced considerable difficulty in carrying out the task entrusted to them, but we are glad to be able to state that the result is much more satisfactory than we expected. As to the future, we have no doubt that by a little additional expenditure, especially if legislative powers are given us to compel parties who may possess it to furnish the necessary information, we will be able to present, year by year, fairly accurate statistics, both of the quantity of fish caught and sold fresh, and of their value.

Result more satisfactory than anticipated.

Particulars of Statistics collected.

Appendix C. gives such statistical information regarding these fisheries as we have been able to make up, based on the returns collected by the officers for the twelve months above mentioned. The Appendix shows the total quantities of the different kinds of white and shell fish caught on the coasts, with the estimated value, but excluding those herring, cod, and ling, accounted for *as cured* in Appendices A and B, and also the respective quantities taken in each of the 26 districts, with their estimated values.

Quantities and values of White Fish sold Fresh.

From the Appendix it will also be seen that the most important of the white fish sold fresh, as regards quantity and value, is the haddock. Of it 543,568 cwts. were caught in the twelve months, the estimated value of which was £340,693. Next, as regards quantity, is the cod, of which 156,430 cwts. were caught, the value being £81,376; next the herring, 114,887 crans, value £149,433; next the whiting, 94,157 cwts., value £41,851; and next the flounder, 67,226 cwts., value £48,409. The total estimated value of these white fish, and of the others embraced in the returns, amounts to £757,710 for the year. As to Shell-fish—Of mussels, there were 281,569 cwts., valued at £16,548; of crabs, 35,393 cwts., value £19,716; of lobsters, 7,498 hundreds, £32,966; and of oysters, 6,456 hundreds, £3,406; the value of these and the other shell-fish enumerated being £82,945; while the gross total value of the white fish and the shell-fish was estimated to be £840,655.*

Of Mussels, Crabs, Lobsters, and Oysters.

Best districts for Haddock and Cod.

The districts which supplied the largest quantity of haddock and cod are Eyemouth, Leith, Anstruther, Montrose, Aberdeen, and Buckie. At the Eyemouth and Anstruther stations the

* For the total estimated value of the Fisheries of Scotland, amounting to £3,286,242, 7s. 6d., see page lxiv.

haddock fishery was above the average of former seasons, and the quality was generally very fair. The sprat fishery was prosecuted in the upper reaches of the Firth of Forth, the Firth of Tay, and the Moray Firth. It was more than usually abundant, while in the preceding season it was almost an entire failure. The gross catch amounted to 43,428 crans, of which about equal quantities were got in each of these firths. On many occasions the takes were so great that only a small portion could be sold for food, although the price asked was very low. A portion was used as bait, for which sprats are well adapted; but the great bulk of the fishing was sold for manure.

Fish sold Fresh.

Sprat Fishing.

Abundant Catch.

Used for Bait, but bulk sold for Manure.

The districts which yielded the largest quantity of mussels and other shell-fish were Leith, Anstruther, Montrose, Cromarty, and Greenock.

Best districts for Shell-fish.

A comparison cannot, of course, be made of these fisheries in the twelve months for which the returns are given with the produce of previous years; but it is believed that the fishing of 1883–84 was more abundant than it had been for a long time past, particularly in the Eyemouth, Leith, and Anstruther districts, and that in no previous year were the markets better supplied with all kinds of fresh fish than in 1883.

Comparison with former years not possible.

Productive Fishing in 1883-84.

FISHING BOATS AND VESSELS.

Fishing Boats.

Table I. Appendix D, gives an account of the number of boats, decked and undecked, *irrespective* of the places to which they belong, employed in the herring fishery, Scotland, in the season of 1883, in a selected week for each district; with the number of fishermen and boys by whom they were manned; of coopers, gutters, packers, and labourers employed at the said fishery in the week thus selected; and the total number of all such fishermen and other persons so employed.

Fishing Boats.

Boats employed in Herring Fishery in selected week.

The following table shows the number of boats, decked and undecked, employed in the shore curing herring, cod, and ling, and other fisheries, Scotland; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed in the years 1882 and 1883:—

Boats, &c. employed in the Herring and other Fisheries in 1882 and 1883.

Years.	Beam Trawl Vessels and Fishing Boats.	Fishermen and Boys.	Fish Curers.	Coopers.	Other Persons (Estimated).
1882, ...	14,973	48,296	1,072	2,564	47,464
1883, ...	15,294	49,722	1,031	2,736	47,522
Increase in 1883, . .	321	1,426	...	172	58
Decrease in 1883, .	...	...	41	...	...

Increase of Boats, Fishermen, &c.

Fishing Boats and Vessels.

Boats and Fishermen continue to increase.

The number of boats and fishermen and boys continues to increase from year to year, the increase in 1883 being, as shown above, 321 boats and 1426 fishermen and boys on the preceding year. The decrease of 41 fish-curers was owing to there having been two or more curing stations occupied last year by one individual, and the failure of the Loch Hourn herring fishery.

Capital Employed in 1882 and 1883.

The amount of capital employed last year in boats, nets, and other fishing material was much greater than 1882. The particulars of this increase are exhibited in the following table:—

Years.	Value (Estimated) of—			
	Beam Trawl Vessels and Boats.	Nets.	Lines.	Total.
1882, . . .	£646,883	£711,039	£114,278	£1,472,200
1883, . . .	780,361	753,760	120,039	1,654,160
Increase in 1883, .	£133,478	£42,721	£5,761	£181,960

Increase in 1883.

Cause of Increase in Capital.

This very large increase is chiefly due to the additional capital invested in the large class of fishing boats and beam trawl vessels which are now being so extensively used, with their more expensive equipment and fishing material.

Details of Boats and Capital employed.

Table II. Appendix D, shows the number and tonnage of boats, decked and undecked, employed in the herring and other fisheries of Scotland last year, with the districts to which they belonged; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed; with the estimated value of boats, nets, lines, and other fishing material.

Vessels.

Vessels. Tonnage of Shipping and number of Seamen engaged.

Table III. Appendix D, shows the tonnage of shipping and the number of seamen engaged in the trade of the herring and cod and ling fisheries of Scotland, last year, distinguishing those employed in importing stave wood, hoops, and salt, in carrying herrings or cod-fish coastwise, or exporting them abroad; and distinguishing British from foreign tonnage and men.

Vessels and Boats.

Vessels and Boats. Tonnage in 1882 and 1883.

The total tonnage of vessels and boats, and the number of persons employed in the herring, cod, and ling, and other fisheries, Scotland, last year also show an increase over those of 1882. The particulars are—

Fishing Boats and Vessels.

Abstract.	Total Tonnage and Persons Employed.			
	British.		Foreign.	
Years.	Tons.	Persons.	Tons.	Persons.
1882, . . .	275,592½	109,797	36,318	2016
1883, . . .	282,712	111,038	46,780	2484
Increase in 1883, .	7,119½	1241	10,462	468

Increase of Tonnage and Persons.

Table IV. Appendix D, gives abstract accounts of the tonnage of vessels and number of men; the tonnage of boats and number of fishermen and boys; and the number of other persons employed in the herring and cod and ling and other fisheries of Scotland last year.

Abstract of Tonnage and Persons employed.

Registration of Boats.

The number of applications in 1883 made through the Board's officers to register fishing boats under the 'Sea Fisheries Act, 1868,' was 963, the number of registers issued was 958, and the number of registers examined and endorsed was 5162. These numbers, as compared with the corresponding numbers of 1882, are an increase of 38 in the applications to register, and of 33 in registers issued, but a decrease of 132 in registers examined and endorsed. The number of boats detained for non-compliance with the Act was 419, being an increase over the preceding year of 230. The enforcement of the regulations regarding the registering, lettering, and numbering of boats continues to have a most beneficial effect in maintaining good order at sea, and preventing wilful destruction of fishing material; but, owing to complaints having been made of the defective lettering and numbering of fishing boats upon the west coast, and the difficulty of enforcing the regulations under the Sea Fisheries Act, 1868, in regard thereto, we made a representation on the subject to the Board of Trade, with a suggestion that a public notice, under the authority of that Board, might be issued warning owners and masters of boats of the penalty they incurred by a non-observance of the regulations under the Act. Such a notice was accordingly prepared by the Registrar-General of Shipping and Seamen, and copies issued to the Customs and Coast Guard officers for circulation,—and upon the recommendation of the Board, copies were also sent for distribution by the fishery officers in their respective districts, with instructions to co-operate, in so far as practicable, with the officers of Customs and Coast Guard. It is hoped by this means that a more thorough observance of the regulations will in future be maintained.

Registration of Boats.

Number registered in 1883 compared with 1882.

Increase in Detentions for non-compliance with the Regulations.

Importance of Regulations.

Representation to Board of Trade.

Public Notice issued.

Boat Building.

As a result of the prosperous state of the fisheries, boat builders have been exceedingly busy during the past year in executing

Boat Building.

Fishing Boats and Vessels.

First-class decked Boats in demand.

Size of Boats.

orders from fishermen. Large sized decked boats are in great demand. Those built in 1883 measured from 44 to 56 feet of keel, but some recent orders have been given for boats of even a larger size.

BEAM TRAWLING.

Beam Trawling.

Steam Trawlers gradually superseding Sailing Trawlers.

Varieties of Fish caught.

Where landed.

Beam trawling was prosecuted last year with a considerable amount of energy, and with very fair success, especially by steam trawlers. These vessels, which are gradually superseding sailing trawlers, range from off the coast of Northumberland to the coast of Caithness, and when the weather is at all moderate they go from 20 to 50 miles to sea. At other times they fish nearer land. The trawl fishermen are getting better acquainted with the grounds where the best takes are to be got, and they are able to work their nets more efficiently than formerly. The trawlers supplied the markets with large quantities of excellent cod, ling, haddock, whiting, halibut, turbot, skate, sole, plaice, and various other kinds of useful fish. The catches were landed chiefly at Berwick, Eyemouth, Newhaven, Granton, Montrose, Aberdeen, and Wick, on the east coast; and, usually, at Stranraer and Ayr, on the west coast; and, as a rule, they realised good prices.

Haddocks plentiful notwithstanding Beam-Trawling.

Notwithstanding the increase which has recently taken place in beam-trawl fishing, the success of the line fishermen last year in the haddock fishing in the districts of Eyemouth, Leith, Anstruther, and on the usual fishing grounds along the Caithness coast, was greater than for many years past.

There were landed in the Eyemouth district alone no less than 95,332 cwts. of haddocks, the value of which was estimated to be £58,004. With reference to the questions which have arisen between trawl fishermen and line fishermen, as a

Royal Commission.

Royal Commission is now inquiring into the whole matter of beam-trawling, we deem it better to confine ourselves simply to stating the facts given above; but we think it right to report that we

Information collected for it.

collected for that Commission, at its request, through our fishery officers, a considerable amount of information bearing upon this subject.

METEOROLOGY.

Meteorology.

Fishery Officers aiding Meteorological Society.

The Board's fishery officers, as in previous years, furnished returns of the fishing and weather during the season of 1883, in so far as their regular duties permitted them, for the information of the Scottish Meteorological Society in its investigations into the relations of the herring fishery to meteorology. As formerly, the Society lent a number of deep-sea thermometers for observing the sea temperature, which were intrusted to competent fishermen in the fishery districts, who were instructed as to the manner of recording observations day by day; and the results, along with a daily register of the weather made on the fishing grounds, were sent to the Society at the close of the season.

FISHERY BAROMETERS.

We have to express our thanks to the Meteorological Department, London, who still continue to show their unabated interest in the welfare of those engaged in the fisheries by supplying on loan Barometers to fishing stations. During the course of the past year the following additional stations have, on the recommendation of the Board, been supplied with barometers,—viz., Balta Sound and Uya Sound, in the island of Unst, Shetland; and Symbister, in the island of Whalsey, Shetland. These barometers have been put up under the directions of the Board's officer of the district, in central and suitable localities, and they have been received by the fishermen with much gratitude. We have also to express our thanks to the Shipwrecked Mariners' Society for their kindness in making a free gift to each of the fishing stations of Eyemouth and Burnmouth, in Berwickshire, of an outside aneroid barometer set in an oak case, with thermometer and chart therein, and also for supplying on loan aneroid barometers, in hand boxes, to six skippers of boats at Eyemouth, and two skippers at Burnmouth. The liberality of this act on the part of the Society has been much appreciated by the fishermen of the district.

Loan of Barometers by Meteorological Department.

Additional Stations where placed.

Presentation of Aneroids by Shipwrecked Mariners' Society.

MARINE POLICE.

In the Report on the Fishery Acts and Regulations and their Amendment, which we prepared at your request in May 1883, and which was afterwards presented to Parliament, as embodying some of the matters on which, in our opinion, additional legislation was most urgently needed, the subject of 'Marine Police' was left over for further consideration.

Marine Police.

Since then the whole of the statutes from which the Board derives its powers have been submitted to a careful examination by a Committee of our number, in the expectation that it might be necessary for us to press for a Consolidating Act, in which the regulations now in force would be simplified and amended, and brought within the scope of one general measure. A law intended for the guidance of fishermen should, above all things, be simple and easily understood, and not consist, as at present, of a confused series of enactments passed at different times, and qualifying each other in so many ways, that it is sometimes hard to understand what is left and what has been taken away, or how much of what remains is not qualified by something else. But, while we were considering the subject, the Sea Fisheries Act of 1883 came into force; and as we find it an important advance, in some respects, on the former law, and that it proceeds on the same lines as we ourselves had in contemplation, we have come to the opinion that, until at least some experience has been had of its practical working, it will not be necessary to press for any further legislation, as regards marine police.

Examination of Statutes by Committee.

Desirability of Consolidation.

Superseded by Sea Fisheries Act, 1883.

The general superintendence of the fisheries at sea is under this Board intrusted to H.M.S. 'Jackal,' Lieut. J. R. Prickett in

General Superintendence of Fisheries at Sea.

Marine Police.

Fisherman's readiness to submit to officers in authority.

This readiness on the part of the fishermen to submit to officers in a position of authority, and whose character for justice and fair dealing they have learnt to respect, is probably the reason why, without any express statutory power, the commander of the Board's cruiser 'Vigilant,' as well as the officers in charge of the 'Jackal' and other vessels engaged in the work of superintendence, are frequently able to intervene between fishermen on occasion of some dispute with such good effect. These disputes arise out of collisions between boats, injuries to nets and lines, and numberless questions of damage to the boats and property. When the parties join in appealing to the superintending officers, the latter, after due inquiry and investigation into the facts of the case, often succeed in settling the matter to the satisfaction of all concerned, and thus put an end to complaints, which if left to take their ordinary legal course, might give rise to expensive, troublesome and vexatious questions.

Settlement of disputes.

Therefore, it appears to us that the above valuable statute, which came into force on the 15th May last, and which has practically superseded the older and more imperfect Acts, is an important advance in the right direction. The new rules will enable fishermen to understand their rights and duties in the prosecution of their industry on a common fishing ground, and the fact that its provisions are liable to be enforced by fine and imprisonment will no doubt contribute considerably to their due and proper observance. Some of the rules may no doubt give rise to interesting and not easy questions of construction. Already we have been appealed to for advice, as to the effect on the Haaf Fishing in Shetland of Art. 17, enacting that no net or other fishing engine shall be set or anchored on grounds where drift net fishing is actually going on, and doubtless similar questions are likely to arise.

Effect of Article 17 on Haaf Fishing in Shetland.

Damage by trawlers to drift net or long line fishermen.

We notice with satisfaction that any question which may arise respecting injuries done by trawlers to drift net or long line fishermen is dealt with in a manner which has always appeared to us to be the sound and simple principle, viz., that on proof of damage in fact, the trawler will not escape liability except on proof that he is free from blame.

Numbering, Lettering, and Registering Regulations.

The regulations affecting the numbering, lettering, and registering of fishing boats now in force are contained in three Orders in Council, bearing date 18th June 1869, 26th February 1880, and 3rd May 1882, passed in virtue of the Act 31 and 32 Victoria, chapter 45, sections 22 to 26. By the recent Act certain additional regulations on this subject fall to be added to the existing code. They are contained in articles 5 to 12 inclusive of the International Convention, and an offender is made liable, on summary conviction, to certain penalties prescribed by the Act. We think it is very desirable that these different regulations, in so far as they are still in force, should be all collected and clearly set forth in one document.

Sea Fishery Officers.

The enforcement of the late statute is intrusted by section 11 to certain officials, who are termed Sea Fishery Officers. These include, amongst others, every commissioned officer of any of Her Majesty's ships in full pay, and every officer of or appointed by the Board of Trade. A warrant has been received from the Board of Trade appointing the commander and chief officer of the

'Vigilant,' as well as the two inspectors, and all the fishery officers in the Board's service, to be Sea Fishery Officers under the Act, by whom, subject to the directions of the Board, its provisions may be enforced. Marine Police. Appointment of Board's Officers as such.

SALMON FISHERIES.

Since the constitution of this Board in the end of 1882, Mr Young, inspector of salmon fisheries, has made three inspections by the direction of the Board, with Reports following thereupon. The first of these was made in the spring of last year, and comprised the nineteen salmon rivers on the east coast, from the Forth to the Kyle of Sutherland, both inclusive. Nearly all the principal salmon rivers in Scotland are comprehended in this group; and the annual value of the salmon caught in these nineteen rivers, and in the fixed nets on the adjoining sea-coast, is probably at least £125,000, while the number of men employed in net-fishing and in watching the rivers is upwards of 2000. The gross yearly value of the salmon caught in the fishery districts of the Tay and Spey alone must be about £70,000. The Report on these east coast rivers was appended to our First Annual Report to Parliament, in which our views generally in regard to it were submitted. It gives a full description of the rivers inspected; of the modes of fishing employed; of the obstructions, natural and artificial, to the passage of salmon; of the pollutions by which some of these rivers are contaminated; and of the salmon disease which was generally prevalent. It also discussed the provisions of the existing Salmon Fishery Acts, and the improvements which seem called for in any future legislation. Inspection of Salmon Fisheries by Mr Young.

During last summer, Mr Young also inspected, by direction of the Board, the salmon rivers on the Scotch side of the Solway Firth and the salmon rivers of Ayrshire. In May of the present year, he likewise made a personal inspection of the rivers and lochs above the Falls of the Tummel, one of the principal tributaries of the Tay, that would be opened up to salmon by placing an efficient fish-way on these falls. Thirty miles of rivers, with much good spawning ground, and many fine angling streams and pools, and 20,000 acres of lochs, would be opened up to salmon by such a ladder. A fishway on the Macdonald or Virginia system of fishway building, which has been so successful in the United States of America, and a model of which was exhibited at the International Fisheries Exhibition in London, would probably be the cheapest and most effectual. The Falls of Tummel are 16 feet high, and the cost of a fishway, on the Macdonald principle, would not, it is believed, exceed £350. Colonel Macdonald, the inventor of this fishway, is Commissioner of Fisheries for the state of Virginia; and, in the Appendix to his Report of 1883 to the Governor of Virginia, there is a full account of this fishway, accompanied by several illustrative diagrams. Mr Young's second and third Reports above alluded to form Appendix G, at the end of this Report; and in regard to the second of these Reports we have the honour to inform you that, after having given it our best consideration, we approved of it generally, and resolved that after Mr Young has completed his inspection of the Inspection of Solway and Ayrshire Salmon Rivers. Inspection of Lochs and Rivers above Falls of Tummel.

Salmon Fisheries.

remaining salmon rivers in Scotland, and reported thereon to us, we will submit to you a definite Report on the whole subject of the Salmon Fisheries in Scotland, and the legislation which may be required in connection therewith.

Report on Falls of Tummel.

But as regards Mr Young's third Report, which deals with the question of placing a fishway on the Falls of Tummel, we deemed this matter of so much importance that, after Mr Young had reported on it to us, we felt it to be our duty to communicate with you, which we did on 27th May last, as to the desirableness of a short Act of Parliament being passed, so as to give effect to the recommendations contained in that Report, as well as to deal with other obstructions of a similar nature in the salmon rivers of Scotland, without waiting till the time when we propose to report on the whole question of the Salmon Fisheries of Scotland. The following is the formal resolution which we adopted on the subject, and which was duly communicated to you:—

Special Act of Parliament suggested.

Resolution of Board.

'The Board having considered the Report by Mr Young on the 'opening of rivers and lochs now closed against salmon, by the 'existence of such obstructions as the Falls of Tummel, the Falls 'of Mounessie, and the Falls on the Conon, approve of said 'Report; and having regard to the extensive area of spawning and 'angling water which could be opened in different districts of 'Scotland by the removal of said obstructions and the introduction 'of an efficient fishway, resolve to transmit a copy of said Report 'to the Secretary of State, with a request that a short Act should 'be brought in by the Government, giving District Boards the 'requisite compulsory powers, subject to such control on the part 'of this Board or otherwise, as may be considered just.'

Mr Young is about to start on an inspection of the salmon rivers in Caithness and Sutherland, and on the west coast of Scotland from the Sutherland march to the Mull of Cantire. This will complete his examination of the rivers on the mainland of Scotland, leaving only those in the islands for future inspection.

Salmon Fishing Season of 1883.

The fishing season in Scotland during the year 1883 was a most successful and productive one. 34,506 boxes of salmon were sent to London alone; and, if we allow for those sent to other parts of England, and for those consumed at home, the total value of the salmon placed in the market from the whole of Scotland during 1883 must have been not less than £350,000. It is, perhaps, worth noticing that the number of boxes of Scotch salmon sent to Billingsgate in 1883 is the largest during the last 50 years, with only two exceptions, namely in 1835, when 42,330 boxes were sent, and in 1842, when 39,417 boxes were sent. And not only was the netting successful, but the rod-fishing in many of the rivers was exceptionally good. 5000 salmon and grilse were killed by the rod in the Aberdeenshire Dee; and in the Helmsdale, in Sutherlandshire, a much smaller river than the Dee, at least 800 fish were captured.

Salmon Disease.

Coincident, however, with this successful fishing, there was a great deal of salmon disease in the east coast rivers, which extended from the Tweed, on the south, to the Deveron, on the north —scarcely a river escaping. The Tweed is a border river, and part of its course is in England. It has special Commissioners; is

regulated by the Tweed Fisheries Acts of 1857 and 1859; and is not under the superintendence of the Fishery Board. It is, therefore, no part of our duty to notice the salmon disease in it. That will be found fully discussed in the Annual Reports of the Tweed Commissioners. But, in the Don and the Deveron, the disease was very virulent in the course of last year; and yet in both these rivers, as well as in the Aberdeenshire Dee, where the disease showed itself to a much smaller extent, the fishing was unusually good. All these rivers were full of salmon. Mr Young was instructed to visit them in the latter part of last year, and he gave in a Report to the Board on the salmon disease which had broken out in them. The inspector of the Don said that 700 fish, that had died from the disease, had been taken out of the lowest 12 miles of the Don and buried; and, on the Deveron, it was stated that the number of diseased fish taken out was six times as many as had ever been seen before. On the Dee, a quick, sharp-running stream, with scarcely any pollutions or obstructions, there was no epidemic of the disease, though there were several sporadic cases. In all these rivers, the disease appeared first among the ascending fish, close to the sea, and then gradually extended inland to the upper reaches of the river. Some of the water-bailiffs and gamekeepers examined by Mr Young, stated that they had taken diseased fish from the river close to the sea, with the sea-lice on them, and said that they thought the disease had been contracted in the sea, contrary to the generally received opinion that salt water exercises a curative effect upon the disease. The explanation of this is probably to be found in what Professor Huxley writes on the subject in his elaborate and interesting account of the salmon disease in the Twenty-first Annual Report of the Inspectors of Salmon Fisheries for England and Wales. He there writes as follows:—

Salmon Fisheries.

'There is great deal of reason to believe that the *Saprolegnia* 'growing on salmon is killed by salt water; and that the injured 'skin may heal and become covered with a new epidermis when a 'diseased salmon enters the sea. But the discovery that the root-'hyphæ of the *Saprolegnia* ramify in the derma, where the sea 'water cannot reach them, raises a curious and important question. 'It becomes possible that a diseased salmon returning to the sea 'may regain a healthy epidermis and appear perfectly sound; but 'that, like a potato-tuber invaded by *Peronospora* just before the 'approach of winter, the fungus in the derma may simply lie 'dormant, and be ready to spring into activity as soon as the fish 'returns to fresh-water. Cases of the appearance of the disease in 'quite fresh run fish are occasionally reported, which would be 'readily explicable should this supposition turn out to be well-'founded.'

SUMMARY.

A comparison of the accounts of the herring fishery of the past two years shows that the total quantity of herrings cured in 1883 was 1,269,412½ barrels; the total quantity branded was 470,995½ barrels; and the total quantity exported 890,760½ barrels; being a decrease on the preceding year of 13,561 barrels in the quantity

Totals of Herrings Cured, Branded, and Exported.

Summary.

cured, but an increase of 8383 barrels in the quantity branded, and of 64,777¾ barrels in the quantity exported.

Totals of Cod and Ling Cured and Exported.

The returns of the cod and ling fishery show that 120,335¾ cwts. were cured dried, and 7310 barrels cured in pickle, and that the quantity exported was 56,525½ cwts. cured dried, being a decrease on the preceding year of 1001¼ cwts. in the quantity cured dried, and 427 barrels in the quantity cured in pickle. In the quantity exported there was an increase of 28½ cwts. cured dried, but a decrease of 2 barrels cured in pickle.

Number of Boats and Fishermen. Value of Boats and Fishing Material.

The number of fishing boats in Scotland was 15,294; of fishermen and boys 49,722; and the estimated value of boats, nets, lines, and other fishing material used in the herring, cod, and ling fisheries was £1,654,160, being an increase on the preceding year of 321 boats, and 1426 fishermen and boys, and of £181,960 in the estimated value of boats and fishing material.

Estimated Produce and Value of Fisheries.

The total estimated produce and value of the fisheries of Scotland, including the salmon fisheries, for the year ending 31st March last, as regards the fish sold fresh, and that ending 31st December 1883, as regards the other fisheries, are as follow:—

Cured Fish.

CURED FISH—

Herrings, Cod, and Ling.	Herrings, 1,269,412½ barrels, at 30s. per barrel, . .	£1,904,118 15 0	
	Cod and Ling, { 120,335¾ cwts. dried, at 30s. per cwt., / 7,310 barrels pickled, at 30s. per barrel, }	191,468 12 6	
	Total value of Cured Fish, .		£2,095,587 7 6

Fish sold Fresh.

FISH SOLD FRESH—

White Fish.

White Fish—

Haddocks, ...	£340,693 0 0	
Herrings, ...	149,433 0 0	
Cod and Ling, ...	97,297 0 0	
Flounders and other flat Fish, . .	92,194 0 0	
Other kinds of White Fish, . .	78,093 0 0	
Total value of White Fish, .	£757,710 0 0	

Shell Fish.

Shell Fish—

Lobsters, . . .	£32,966 0 0		
Crabs, . . .	19,716 0 0		
Mussels, . . .	16,548 0 0		
Oysters and other kinds of Shell Fish, . .	13,715 0 0		
Total value of Shell Fish,		82,945 0 0	
Total value of Fish sold Fresh,			840,655 0 0

Salmon.

SALMON, ... 350,000 0 0

Total estimated value of Fisheries.

TOTAL estimated value of the Fisheries of Scotland for year ended 31st March 1884, as regards Fish sold Fresh, and for year ended 31st December 1883, as regards the other Fisheries, ... £3,286,242 7 6

FINANCE.

Brand Fees.

The total amount of brand fees collected for the year ended 31st December 1883 was £7850, 12s. 6d., which, compared with the collection for the previous year, viz. £7710, 16s. 6d., showed an increase of £139, 16s. In terms of the statute 21 and 22 Vict. cap. 69, the entire amount is paid into Exchequer, but since the report of the Herring Brand Committee of 1881, and in accordance with its recommendations, the surplus brand fees, after deducting the cost of collection, have been repaid to the Board in the form of a Parliamentary grant for building or repairing piers and harbours, and for the extension of telegraphic communication to remote fishery districts.

Application of Surplus.

Cost of Collection.

The estimated cost of collection, calculated on the basis recognised by the Treasury in fixing the amounts to be repaid to the Board, is £4987; and if to this be added the proportion of pensions (£329), and stationery (£99), chargeable against the brand fees of 1883, it will be found that the total cost of collection for that year was £5415, which, if deducted from the amount received, would leave a balance in favour of the brand of £2435.

Parliamentary Vote.

The sum voted by Parliament for the service of the Board in 1883–84 was £17,740, but if from this be taken the annual grant of £3000 for building or repairing piers and harbours, secured under 5 Geo. IV. cap. 64, and included in the Fishery Board vote, the surplus brand fees admitted by the Treasury as £2400, and inserted in the Parliamentary estimates for 1884–85, and the total cost of collecting the fees, viz., £5415, it will be seen that the actual expense of maintaining the Board and its staff of officers, including the inspector of salmon Fisheries and naval superintendents, is under £7000 per annum. This estimate is exclusive of the rent, &c., of the Board's Office, public rates, audit, and superannuations, and stationery and printing, not included in above statement.

Cost of maintaining Board.

Agitation for increased Grants.

During the current year there has been considerable agitation among the fishing interests, and the different public bodies in Scotland, in favour of additional assistance being provided by Government to enable the Board to continue the labours in which it is now engaged, particularly in the direction of building and improving piers and harbours, in extending telegraphic communication, and scientific investigations, to all of which we have already adverted. We now consider it our duty again to press the matter earnestly on your attention.

Exhibit to Fisheries Exhibition, London.

As formerly reported, we had the pleasure of sending an exhibit last year to the Great International Fisheries Exhibition, London. That exhibit consisted of the following articles:—(1) a white herring standard 'cran' measure; (2) a white herring barrel; (3) a white herring half-barrel; (4) a set of gauging instruments; and (5) a set of crown branding irons. There was also sent a bound copy of the Board's Annual Reports to Parliament for the years from 1870 to 1882. We have now the satisfaction of

Award of Gold Medal and Diploma.

stating that the Committee of the Exhibition awarded us a gold medal and a diploma of merit for this exhibit.

Retirement of Inspector of Fisheries.

Towards the end of last year Mr Laurence Lamb, inspector of fisheries to the Board, having completed a service of upwards of forty years, applied for his retirement upon superannuation, which was accordingly granted him by the Lords of Her Majesty's Treasury. We much regret that by this retirement we were deprived of the services of an able and efficient officer, and we had the satisfaction of recording in our minutes an expression of the high estimation in which these services have been held.

Arrangements consequent thereupon.

The vacancy thus occasioned has been filled up by the appointment of Mr George Reiach, assistant inspector; and Mr James Low, fishery officer, Wick, has been appointed to succeed Mr Reiach. Both of these officers, from their ability, energy, and long experience in the service, are thoroughly qualified to fill the positions in which they have been placed.

We have the honour to be,

SIR,

Your most obedient Servants,

(Signed) THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman*
GEO. H. M. THOMS.
ALEXR. FORBES IRVINE.
J. R. G. MAITLAND.
S. WILLIAMSON.
J. COSSAR EWART.
J. MAXTONE GRAHAM.
JAS. J. GRIEVE.

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APPENDIX A.—TABLE I.

HERRING FISHERY.—ACCOUNT of the Number of Vessels fitted out in SCOTLAND for the HERRING FISHERY in the Year ended 31st December 1883; the Districts from which fitted out; the Tonnage and Number of Men; the Netting, Salt, and Barrels Shipped; and the Barrels of White Herrings Cured.

DISTRICTS.	Vessels.	Tonnage.	Men.	Netting.	Salt.	Barrels.	Herrings Cured.				Total Cured on Board of Vessels.
							Gutted.		Ungutted.		
							Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but *not* within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	Number.	*Tons.*	*Number.*	*Sq. Yards.*	*Bushels.*	*Number.*	*Barrels.*	*Barrels.*	*Number.*	*Number.*	*Barrels.*
Aberdeen, . . .	1	81	11	39,000	1,300	600	438	...	8	...	446
Peterhead, . . .	2	100	22	139,200	3,300	1,220	974	102	80	...	1,156
Findhorn, . . .	1	51	9	32,500	800	239	239	...	...	...	239
Stornoway, . . .	4	188	18	7,200	1,610	480	...	...	...	...	...
Loch Carron and Skye, .	23	622½	71	168,000	6,148	4,102	2,415	...	...	50	2,465
Fort William, . .	15	147	43	91,000	2,570	2,420	700	20	71	...	791
Inveraray, . . .	13	611½	87	8,000	5,630	1,275	3,002	...	...	29,886	32,888
Rothesay, . . .	6	74	17	...	828	443	265	...	...	...	265
Greenock, . . .	6	160	24	...	2,780	1,260	3,491½	...	...	158	3,649½
Total, . .	71	2,035	302	484,900	24,966	12,039	11,524½	122	159	30,094	41,899½

Note.—The above 71 Fishing Vessels made 77 Voyages.

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE II.

HERRING FISHERY.—ACCOUNT of the Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND by Fish-Curers on Shore in the Year ended 31st December 1883; and the Districts in which Cured, distinguishing the Herrings Cured Gutted from those cured Ungutted.

DISTRICTS.	Herrings Cured Gutted.		Herrings Cured Ungutted.		Total Cured on Shore.
	Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but *not* within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	Barrels.	*Barrels.*	*Number.*	*Number.*	*Barrels.*
Eyemouth,	20,459	2,756	5,241	11,809	40,265
Leith,	333	31	...	1,790¼	2,154¼
Anstruther,	282	17	503	4,413	5,215
Montrose,	14,319	3,009½	844	3,524	21,696½
Stonehaven,	9,359	768	433	5,189	15,749
Aberdeen,	32,933	1,980	1,785	14,684	51,382
Peterhead,	166,938	3,533	1,040	9,923	181,434
Fraserburgh,	179,924½	3,391	258	9,254	192,827½
Banff,	25,595½	245	32	...	25,872½
Buckie,	13,587	75	74	1,794	15,530
Findhorn,	3,483	57	43	100	3,683
Cromarty,	1,350	...	23	...	1,373
Helmsdale,	10,008	...	...	1,010	11,018
Lybster,	18,548	250	...	540	19,338
Wick,	135,449	11,023	1,997	7,199	155,668
Orkney Isles,	40,615	5,470	175	112	46,372
Shetland Isles,	250,664	2,223	254	3,346	256,487
Stornoway,	53,509	99	...	14,555¼	68,163¼
Loch Broom,	2,102	...	...	372	2,474
Loch Carron & Skye,	1,598	...	434	785	2,817
Fort William,	3,675	140	160	4,440	8,415
Campbeltown,	980	...	...	48,109	49,089
Inveraray,	420	...	...	18,186	18,606
Rothesay,	175	...	11	2,883	3,069
Greenock,	...	...	...	2,314	2,314
Ballantrae,	67	...	1,293	25,141	26,501
Total,	986,373	35,067½	14,600	191,472½	1,227,513

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE III.

HERRING FISHERY.—ACCOUNT of the Total Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND, on Board of Vessels and on Shore, in the Year ended 31st December 1883; distinguishing the Herrings Cured Gutted from those Cured Ungutted.

DISTRICTS.	Herrings Cured Gutted.		Herrings Cured Ungutted.		Total Herrings Cured on board of Vessels and on Shore.
	Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but *not* within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	Barrels.	*Barrels.*	*Number.*	*Number.*	*Barrels.*
Eyemouth,	20,459	2,756	5,241	11,809	40,265
Leith,	333	31	...	1,790¼	2,154¼
Anstruther,	282	17	503	4,413	5,215
Montrose,	14,319	3,009½	844	3,524	21,696½
Stonehaven,	9,359	768	433	5,189	15,749
Aberdeen,	33,371	1,980	1,793	14,684	51,828
Peterhead,	167,912	3,635	1,120	9,923	182,590
Fraserburgh,	179,924½	3,391	258	9,254	192,827½
Banff,	25,595½	245	32	...	25,872½
Buckie,	13,587	75	74	1,794	15,530
Findhorn,	3,722	57	43	100	3,922
Cromarty,	1,350	...	23	...	1,373
Helmsdale,	10,008	...	...	1,010	11,018
Lybster,	18,548	250	...	540	19,338
Wick,	135,449	11,023	1,997	7,199	155,668
Orkney Isles,	40,615	5,470	175	112	46,372
Shetland Isles,	250,664	2,223	254	3,346	256,487
Stornoway,	53,509	99	...	14,555¼	68,163¼
Loch Broom,	2,102	...	...	372	2,474
Loch Carron & Skye,	4,013	...	434	835	5,282
Fort William,	4,375	160	231	4,440	9,206
Campbeltown,	980	...	...	48,109	49,089
Inveraray,	3,422	...	...	48,072	51,494
Rothesay,	440	...	11	2,883	3,334
Greenock,	3,491½	...	...	2,472	5,963½
Ballantrae,	67	...	1,293	25,141	26,501
Total,	997,897½	35,189½	14,759	221,566½	1,269,412½

SUPPLEMENTARY NOTE, showing the Number of Barrels of WHITE HERRINGS Cured or Salted on the West Coast of Scotland in the Year ended 31st December 1883, stated by the Districts where the Herrings were caught.

DISTRICTS.	Barrels.
Stornoway,	68,387¼
Loch Broom,	2,474
Loch Carron and Skye,	10,421
Fort William,	9,968½
Campbeltown,	49,089
Inveraray,	49,055
Rothesay,	3,297
Greenock,	2,314
Ballantrae,	26,501
Total,	221,506¾

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE IV.

HERRING FISHERY.—ACCOUNT of the Total Number of Barrels of WHITE HERRINGS Branded in SCOTLAND in the Year ended 31st December 1883; and of the Brandings in each District; with Return of the Fees collected thereon under the Act 21 & 22 Vict., cap. 69.

DISTRICTS.	Total Branded.
Eyemouth,	2,190
Leith,	51
Anstruther,	...
Montrose,	9,656
Stonehaven,	6,793½
Aberdeen,	16,872½
Peterhead,	105,583
Fraserburgh,	90,568
Banff,	17,738½
Buckie,	10,085
Findhorn,	2,836
Cromarty,	830
Helmsdale,	7,884
Lybster,	16,182½
Wick,	63,713
Orkney Isles,	21,130
Shetland Isles,	98,882½
Total,	*470,995½

* Of this number, 143,739½ Barrels were branded Crown FULL.
,, 234,584 ,, were branded ,, MATIES.
,, 38,860½ ,, were branded ,, SPENT.
,, 53,811½ ,, were branded ,, MIXED.
,, ... ,, were branded ,, REPACKED.
470,995½ Barrels. The Fees thereon amounted to £7,849 18 6
Bank Interest, . . . 14 0
Total Receipts, £7,850 12 6

NOTE, showing the Total Number of Barrels in the foregoing Account Branded 'Full,' 'Maties,' or 'Spent.'

DISTRICTS.	Number of Barrels assorted and Branded.		
	Crown *Full.*	*Maties.*	*Spent.*
Eyemouth,	1,113	224	572
Leith,	...	...	51
Anstruther,	...	...	...
Montrose,	4,681½	2,756½	2,115
Stonehaven,	3,319½	2,192½	1,280½
Aberdeen,	7,402	6,813½	2,098½
Peterhead,	44,341	49,817½	9,917½
Fraserburgh,	24,762½	56,716½	7,334½
Banff,	3,885	11,578	978
Buckie,	3,147½	4,015	2,349½
Findhorn,	979	1,074½	506½
Cromarty,	262½	483	84½
Helmsdale,	2,410½	5,171	240½
Lybster,	3,803	10,775	72½
Wick,	9,454	51,243	627
Orkney Isles,	4,167	13,401	156
Shetland Isles,	30,011½	18,323	10,477
Total,	143,739½	234,584	38,860½

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

HERRING FISHERY.—ACCOUNT of the Number of Barrels of WHITE HERRINGS Exported from SCOTLAND in the Year ended 31st December 1883; distinguishing the Export to Ireland, to the Continent, and to places out of Europe; distinguishing also Herrings Cured Gutted from Herrings Cured Ungutted; and Herrings Bung-Packed from Herrings Repacked.

DISTRICTS.	BARRELS OF HERRINGS EXPORTED.							
	To Ireland.			To the Continent.		To Places out of Europe.		Total Exported.
	Bung-Packed.		Barrels of Bulk.	Bung-Packed.		Bung-Packed.	Repacked.	
	Gutted.	Ungutted.		Gutted.	Ungutted.	Gutted.	Gutted.	
	Barrels.	*Barrels.*	*Number.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Eyemouth,	840	...	...	7,028	...	...	...	7,868
Leith,	...	...	...	42,344	...	...	...	42,344
Montrose,	...	...	...	13,746½	...	...	...	13,746½
Stonehaven,	...	...	...	6,170½	...	...	...	6,170½
Aberdeen,	...	...	...	42,360½	...	...	...	42,360½
Peterhead,	...	...	...	146,670	...	...	...	146,670
Fraserburgh,	...	...	...	137,328	...	...	...	137,328
Banff,	...	...	...	17,582	...	...	..	17,582
Buckie,	...	...	...	9,616	...	...	...	9,616
Findhorn,	...	...	...	2,621	...	...	...	2,621
Cromarty,	...	...	...	821½	...	...	...	821½
Helmsdale,	...	...	...	8,583½	...	...	...	8,583½
Lybster,	530½	...	...	16,199½	...	...	...	16,730
Wick,	5,824½	110	...	129,908	...	...	...	135,842½
Orkney Isles,	11,198½	...	...	32,707	...	...	...	43,905½
Shetland Isles,	1,113	...	190	209,705	...	...	...	211,008
Stornoway,	...	...	...	36,880	...	...	...	36,880
Loch Broom,	...	...	...	141	...	...	...	141
Greenock,	4,734½	150	579	...	...	...	144½	5,608
Ballantrae,	...	600	...	...	...	...	...	600
Sent from Scotland to England, and thence exported,	...	...	...	3,232½	...	...	1,101½	4,334
Total,	24,241	860	769	863,644½	...	...	1,246	890,760½

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

SUPPLEMENTARY NOTE, showing the Ports or Places to which the Herrings Exported to the Continent were Shipped.

STATIONS.	BARRELS OF HERRINGS EXPORTED.																	Total Exports to the Continent.
	Russia.							Germany.								Holland.	Other Places on the Continent.	
	Odessa.	Helsingfors.	Petersburg.	Revel.	Pernau.	Riga.	Libau.	Memel.	Königsberg.	Elbing.	Danzig.	Stettin.	Hamburg.	Harburg.	Bremen.	Rotterdam.		
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Eyemouth,	...	...	...	...	...	...	...	...	...	...	2,015	1,857	3,650	...	...	...	...	7,522
Leith,	...	...	1,714¼	...	...	250½	...	...	1,330	...	...	12,952½	25,776¾	...	100	724½	28¾	42,877
Montrose,	...	...	...	...	...	11½	...	...	625	...	5,968½	7,141½	...	...	...	...	...	13,746½
Stonehaven,	...	...	...	...	...	...	...	...	...	...	4,223	761	...	1,186½	...	...	...	6,170½
Aberdeen,	492	50	...	50	711	50	1,158	...	9,394½	...	7,148	18,188	7,324½	...	...	...	...	44,566
Peterhead,	...	...	...	...	760	...	33,424	1,683	25,782	...	10,109	43,323	29,940	...	1,649	...	...	146,670
Fraserburgh,	...	1,050	...	...	...	3,918	23,959	3,064	25,913	1,300	7,201½	45,168	24,898	...	856½	...	...	137,328
Banff,	...	...	...	...	...	...	878	...	4,148½	...	4,318	8,237½	...	...	...	...	...	17,582
Buckie,	...	...	...	...	...	...	...	...	5,915½	...	3,700½	...	...	...	...	...	...	9,616
Findhorn,	...	...	...	...	...	...	...	...	...	...	1,566	1,055	...	...	...	...	...	2,621
Cromarty,	...	...	...	...	...	...	...	...	...	...	...	821½	...	...	...	...	...	821½
Helmsdale,	...	...	...	...	...	...	...	...	1191½	...	...	7,966	...	498	...	...	...	8,583½
Lybster,	...	...	...	...	...	...	...	...	4,021½	...	4,470	5,334½	2,373½	...	...	...	...	16,199½
Wick,	...	...	...	...	...	3,015	8,656	...	16,626	...	37,530½	45,951½	18,129	...	...	...	...	129,908
Orkney Isles,	...	...	...	...	...	...	330	...	4,032	...	10,829½	14,160	3,355½	...	...	...	...	32,707
Shetland Isles,	...	...	1,881	...	...	1,600	4,528	1,637	28,509	...	42,287	96,447½	32,815½	...	...	...	...	209,705
Stornoway,	...	...	24,276½	...	...	...	...	...	...	...	...	7,273½	5,330	...	...	...	...	36,880
Loch Broom,	...	...	...	...	...	...	...	...	...	...	...	141	...	...	...	...	...	141
Total,	492	1,100	27,871¾	50	1,471	8,845	72,933	6,384	126,416½	1,300	141,366½	316,778¾	153,592¾	1,684½	2,605½	724½	28¾	863,644½

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE VI.

HERRING FISHERY.—ACCOUNT of the Number of Crans and Half Crans adjusted as Measures for the Purchase and Sale of Fresh Herrings and Branded in SCOTLAND, in the Year ended 31st December 1883.

DISTRICTS.	Adjusted and Branded.
	Cran.
Leith,	1
Total,	1

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE VII.

HERRING FISHERY.—ABSTRACT showing the Total Quantity of WHITE HERRINGS Cured, Branded, and Exported, year by year, *in so far as brought under cognizance of Fishery Officers*, from the 1st of June 1809 to the 31st of December 1883; distinguishing the Export to Ireland, to the Continent, and to places out of Europe.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Period extending from 1st June 1809 to 5th April 1810,	42,548	47,637½	90,185½	34,701	28,014	...	7,834	35,848
Year ended 5th April 1811,	65,430	26,397½	91,827½	55,662½	28,212	...	9,921	38,133
Year ended 5th April 1812,	72,515½	39,004	111,519½	58,430	30 417½	4,730	27,672½	62,820
Year ended 5th April 1813,	89,900¾	63,587½	153,488¼	70,027½	57,980	11,046½	40,699	109,725½
Year ended 5th April 1814,	52,931½	57,611	110,542½	38,184½	43,061½	23,943	51,399	118,403½
Year ended 5th April 1815,	105,372¼	54,767	160,139¼	83,376	49,635¾	35,891	55,778½	141,305¼
Year ended 5th April 1816,	135,981	26,670¾	162,651¾	116,436	29,456½	15,563	62,668½	107,688
Year ended 5th April 1817,	155,776	36,567½	192,343½	140,018½	36,341	44,432½	57,855	138,628½
Year ended 5th April 1818,	204,270¼	23,420¾	227,691	183,089½	53,386½	43,896	65,057	162,339½
Year ended 5th April 1819,	303,777½	37,116½	340,894	270,022½	89,704	52,333	85,125	227,162
Year ended 5th April 1820,	347,190½	35,301	382,491½	309,700½	101,109½	64,302½	88,104	253,516
Year ended 5th April 1821,	413,308	28,887¾	442,195¾	363,872	125,445	89,524	79,836½	294,805½
Year ended 5th April 1822,	291,626½	24,897¾	316,524¼	263,205½	102,719	34,752	77,485	214,956
Year ended 5th April 1823,	225,037	23,832	248,869	203,110	56,528	38,002½	75,914½	170,445
Year ended 5th April 1824,	335,450	56,740¾	392,190¾	299,631	116,747½	40,231	82,652	239,630½

APPENDIX A.—TABLE VII.—*Continued.*

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Year ended 5th April 1825,	303,397	44,268¼	347,665¼	270,844½	96,409½	35,029½	70,577½	202,016⅓
Year ended 5th April 1826,	340,118	39,115¾	379,233¾	294,422½	121,386½	28,167¾	67,519	217,073¼
Year ended 5th April 1827,	259,171¼	29,324	288,495¼	223,606	78,735	16,701	70,970	166,406
Year ended 5th April 1828,	339,360	60,418	399,778	279,317½	109,108½	24,489½	78,061	211,659
Year ended 5th April 1829,	300,242½	55,737	355,979½	234,827	107,651	28,280½	69,944	205,875½
Year ended 5th April 1830,	280,933½	48,623½	329,557	218,418½	89,680½	24,302	67,672	181,654½
Year ended 5th April 1831,	371,096	68,274¼	439,370¼	237,085	130,300½	61,655½	72,947	264,903
Year ended 5th April 1832,	313,113¾	49,547	362,660¾	157,839½	128,458	31,100¼	57,941½	217,499¾
Year ended 5th April 1833,	353,684½	63,279¾	416,964¼	168,259½	114,137	47,556½	58,991	220,684½
Year ended 5th April 1834,	382,677½	68,853¾	451,531¼	178,000½	149,254	55,852	66,987½	272,093½
Year ended 5th April 1835,	217,242½	60,074½	277,317	85,079½	73,960	34,050	50,795½	158,805½
Year ended 5th April 1836,	399,334	98,280¾	497,614¾	192,317	168,960	48,451½	55,982	273,393½
Year ended 5th April 1837,	290,169	107,660¼	397,829¼	114,192	102,968½	46,777	39,520	189,265½
Year ended 5th April 1838,	382,400	125,374¾	507,774¾	141,552	139,095	57,388½	38,674½	235,158
Year ended 5th April 1839,	382,229	173,330¾	555,559¾	153,659½	149,926	64,870	24,934½	239,730½
Year ended 5th April 1840,	405,379½	138,565½	543,945	152,231	157,359	82,515½	12,647½	252,522
Year ended 5th April 1841,	431,157	126,105¼	557,262¼	154,189	150,517½	90,951½	8,668	250,137
Year ended 5th April 1842,	489,620½	177,624¾	667,245¼	190,922½	187,953	91,069½	5,713½	284,736

APPENDIX A.—TABLE VII.—*Continued.*

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Year ended 5th April 1843,	442,290	181,129¾	623,419¾	162,713	165,327½	120,136½	6,336½	291,800½
Year ended 5th April 1844,	473,556¾	191,803	665,359¾	182,988	127,770	181,953	3,793½	313,516½
Period extending from 5th April 1844 to 5th January 1845,	393,312	132,720¾	526,032¾	140,632	120,293	143,754	2,326½	266,373½
Year ended 5th January 1846,	411,271	121,375	532,646	142,473½	127,027½	113,678	2,488½	243,194
Year ended 5th January 1847,	414,915¼	192,535¾	607,451	156 278½	102,585	148,363½	4,765½	255,714
Year ended 5th January 1848,	372,989½	189,754	562,743½	146,500½	102,690	142,532	4,959	250,181
Year ended 5th January 1849,	392,827	251,541¼	644,368¼	153,944	78,262½	168,049	3,682½	249,994
Year ended 5th January 1850,	507,024½	263,673¾	770,698¼	213,286½	78,889¾	257,108	4,258½	340,256¼
*Year ended 5th January 1851, for Scotland and the Isle of Man only,	378,187	165,822½	544,009½	172,924½	66,138	198,403	2,367	266,908
Year ended 5th January 1852, for do. do.	417,233¼	176,797¾	594,031	201,636½	81,340½	182,659	205	264,204½
Year ended 31st December 1852, for do. do.	375,693	123,094½	498,787½	169,159½	60,414	221,979	1,133	283,526
Year ended 31st December 1853, for do. do.	560,367	217,672¾	778,039¾	248,136½	95,339	242,853¼	4,438½	342,630¾
Year ended 31st December 1854, for do. do.	458,579½	177,982¾	636,562¼	211,844	121,883¾	237,893½	1,919½	361,696¾
Year ended 31st December 1855, for do. do.	582,715¼	183,988¼	766,703½	280,581½	97,377	344,029	858	442,264
Year ended 31st December 1856, for do. do.	466,429½	143,559	609,988½	223,281	89,670¾	256,741	1,199½	347,611¼
Year ended 31st December 1857, for do. do.	465,292½	115,521¼	580,813¾	218,992	58,534	307,275½	1,351	367,160½

* The Collection of Returns for England ceased from the 5th of January 1850, and for the Isle of Man from the 1st of January 1869.

APPENDIX A.—TABLE VII.—*Continued.*

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Year ended 31st December 1858, for Scotland and the Isle of Man only,	470,393¼	165,730¼	636,124	233,374	79,054	269,819	1,331½	350,204½
*Year ended 31st December 1859, for do. do.	381,059¼	110,428	491,487¼	158,676	68,882	203,349½	748	272,979½
Year ended 31st December 1860, for do. do.	496,414½	184,778¾	681,193¼	231,913½	86,413	291,401½	156	377,970½
Year ended 31st December 1861, for do. do.	519,173	149,655½	668,828½	265,347	81,595½	308,334¼	384	390,313¾
Year ended 31st December 1862, for do. do.	656,048	174,856	830,904	346,712	70,879¾	423,182¾	847½	494,910
Year ended 31st December 1863, for do. do.	507,223	147,593½	654,816½	276,880½	72,074½	333,074¼	2,612¾	407,761½
Year ended 31st December 1864, for do. do.	478,781½	164,868¾	643,650¼	217,392	55,420½	307,282	1,805	364,507½
Year ended 31st December 1865, for do. do.	470,559½	151,203½	621,763	216,785	42,063	309,626	1,012	352,701
Year ended 31st December 1866, for do. do.	497,814½	160,332¼	658,146¾	249,510	47,319	328,272½	4,474½	380,066
Year ended 31st December 1867, for do. do.	631,759½	193,829½	825,589	317,421	42,364¼	432,994½	3,345½	478,704¼
Year ended 31st December 1868, for do. do.	445,468½	205,965¼	651,433¾	209,462½	43,414½	323,479¾	1,850½	368,744¾
†Year ended 31st December 1869, for Scotland only	488,831	186,312	675,143	244,522½	32,342½	346,793¾	2,197½	381,333¾
Year ended 31st December 1870, for do.	657,059½	176,101	833,160½	299,381½	41,524	486,064	2,970	530 558
Year ended 31st December 1871, for do.	668,489½	156,986¼	825,475¾	346,639½	46,347	502,534¼	2,724	551,605¼
Year ended 31st December 1872, for do.	671,703½	102,156	773,859½	422,731½	24,147	523,540½	1,943½	549,631
Year ended 31st December 1873, for do.	796,902	142,331½	939,233½	435,274½	32,465½	633,681	1,861½	668,008
Year ended 31st December 1874, for do.	887,002½	113,558½	1,000,561	517,558½	28,137¼	706,967¾	2,209¾	737,314¾

* By Act 21st and 22nd Vict. cap. 69 (1858), there was imposed upon the Branding of Barrels and Half-Barrels of Herrings a Fee of *Fourpence* per Barrel and *Twopence* per Half-Barrel.
† The Collection of Returns for England ceased from the 5th of January 1850, and for the Isle of Man from the 1st of January 1869

APPENDIX A.—TABLE VII.—*Continued.*

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrels.	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Bls. or Crans.*	*Barrels.*	*Barrels.*	*Barrels.*
Year ended 31st December 1875, for Scotland only,	834,822½	108,157½	942,980	523,789½	33,434	624,137½	3,399	660,970½
Year ended 31st December 1876, for do. .	486,238½	111,959	598,197½	252,979½	20,333	378,740	1,350½	400,423½
Year ended 31st December 1877, for do. .	716,871¼	130,847½	847,718¾	397,795	16,085½	543,908¼	1,992	561,985¾
Year ended 31st December 1878, for do. .	771,556	134,212	905,768	456,708	17,445¾	608,969¼	2,519	628,934
Year ended 31st December 1879, for do. .	655,991	185,805	841,796	342,323	8,857½	536,380½	755½	545,993½
Year ended 31st December 1880, for do. .	1,224,198⅓	249,401¾	1,473,600¼	689,286	32,482½	976,300½	1,028½	1,009,811½
Year ended 31st December 1881, for do. .	915,098	196,057¼	1,111,155¼	494,182½	33,459¼	711,448	972½	745,879¾
Year ended 31st December 1882, for do. .	980,755½	302,218	1,282,973½	462,612½	40,377	782,576¼	3,029½	825,982¾
Year ended 31st December 1883, for do. .	1,033,087	236,325½	1,269,412½	470,995¼	25,870	863,644½	1,246	890,760½

N.B.—In the Six Years ended 5th April 1815, the Bounty on Herrings Cured Gutted was 2s. per Barrel, while there was a Bounty at the same time of 2s. 8d. per Barrel, payable by the Excise on the Exportation of Herrings, whether Cured Gutted or Ungutted, but which ceased on the 1st June 1815; in the Eleven Years ended 5th April 1826, the Bounty on Herrings Cured Gutted was 4s. per Barrel; in the Four succeeding Years the Bounty was reduced 1s. per Barrel each Year till the 5th of April 1830, when it ceased altogether.

Fishery Board for Scotland,
Edinburgh, 2nd June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE VIII. (See separate Table hereto annexed).

APPENDIX B.—TABLE I.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the Number of Vessels fitted out in SCOTLAND for the COD and LING Fishery, in the Year ended 31st December 1883; of the Tonnage of the Vessels, and the Number of Men; also of the Quantity of COD, LING, and HAKE Cured on Board.

DISTRICTS.	Vessels.	Tonnage.	Men.	Total Quantity of Cod, Ling, and Hake Cured on board of Vessels.	
				Number of Fish.	Cured Dried.
	Number.	*Tons.*	*Number.*	*Number.*	*Cwts.*
Fraserburgh, . .	9	159	54	21,582	907
Orkney Isles, . .	14	883	157	150,444	5,295
Shetland Isles, .	29	1,373	315	426,271	9,963
Total, . .	52	2,415	526	598,297	16,165

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE II.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the COD, LING, and HAKE taken at the Cod and Ling Fishery in SCOTLAND by Open Boats and Cured on Shore, in the Year ended 31st December 1883; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling, and Hake Cured on Shore.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	Number.	*Cwts.*	*Barrels.*
Anstruther, ...	209,971	8,679	120
Montrose, ...	108,709	3,611	9
Stonehaven, ...	20,134	677	...
Aberdeen, ...	35,038	1,201	...
Peterhead, ...	49,661	1,146	387
Fraserburgh, ...	120,656	3,507	193
Banff, ...	35,617	967	427
Buckie, ...	58,838	576	2,251
Findhorn, ...	25,356	168	955
Cromarty, ...	4,697	...	121
Helmsdale, ...	6,985	...	310
Lybster, ...	10,504	107	317
Wick, ...	69,004	789	2,082
Orkney Isles, ...	396,674	11,729	62
Shetland Isles, ...	1,190,991	45,435	...
Stornoway, ...	444,490	17,503¼	...
Loch Broom, ...	117,932	4,360	68
Loch Carron and Skye, . . .	32,240	880	...
Fort William, ...	50,864	1,761	...
Campbeltown, ...	32,899	1,051½	8
Inveraray, ...	650	23	...
Total, . .	3,021,910	104,170¾	7,310

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX A. TABLE VIII.

CHART SHEWING THE PROGRESS OF THE HERRING FISHERIES, IN SO FAR AS BROUGHT UNDER THE COGNIZANCE OF FISHERY OFFICERS, FROM 1809 TO 1883, AS EXHIBITED IN THE TOTAL NUMBER OF BARRELS OF WHITE HERRINGS CURED, BRANDED, AND EXPORTED, IN EACH YEAR DURING THAT PERIOD.

Note. *In this Chart are included, from 1809 to 1850, returns from certain English districts, which were discontinued at the latter date, with the exception of a few stations in Eyemouth district still continued. It also includes, from 1824 to 1869, returns from the Isle of Man, which were discontinued at the latter date.*

N.B. - Black line indicates Cured; Blue, Branded; Red, Exported.

DRAWN BY Wm C. ROBERTSON, FISHERY BOARD FOR SCOTLAND

APPENDIX B.—TABLE III.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the Total Quantity of COD, LING, and HAKE taken, both by Vessels and by Open Boats, at the Cod and Ling Fishery in SCOTLAND, and Cured, in the Year ended 31st December 1883; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling, and Hake Cured.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	Number.	*Cwts.*	*Barrels.*
Anstruther,	209,971	8,679	120
Montrose,	108,709	3,611	9
Stonehaven,	20,134	677	...
Aberdeen,	35,038	1,201	...
Peterhead,	49,661	1,146	387
Fraserburgh,	142,238	4,414	193
Banff,	35,617	967	427
Buckie,	58,838	576	2,251
Findhorn,	25,356	168	955
Cromarty,	4,697	...	121
Helmsdale,	6,985	...	310
Lybster,	10,504	107	317
Wick,	69,004	789	2,082
Orkney Isles,	547,118	17,024	62
Shetland Isles,	1,617,262	55,398	...
Stornoway,	444,490	17,503¼	...
Loch Broom,	117,932	4,360	68
Loch Carron and Skye,	32,240	880	...
Fort William,	50,864	1,761	...
Campbeltown,	32,899	1,051½	8
Inveraray,	650	23	...
Total,	3,620,207	120,335¾	7,310

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE IV.

COD AND LING FISHERY.—ACCOUNT of the Total Quantity of COD, LING, and HAKE Exported from SCOTLAND, in the Year ended 31st December 1883; with the Districts from which Exported; distinguishing the Export to Ireland, to the Continent, and to places out of Europe; also whether Cured Dried or Cured in Pickle.

DISTRICTS.	Cod, Ling, and Hake Exported.					
	To Ireland.	To the Continent.		To Places out of Europe.	Total Exported.	
	Cured Dried.	Cured Dried.	Cured in Pickle.	Cured Dried.	Cured Dried.	Cured in Pickle.
	Cwts.	*Cwts.*	*Barrels.*	*Cwts.*	*Cwts.*	*Barrels.*
Leith,	12,694	2,336	...	1,335	16,365	...
Orkney Isles,	...	2,137	...	...	2,137	...
Shetland Isles,	14,811	12,610	...	...	27,421	...
Stornoway,	6,484	...	...	...	6,484	...
Campbeltown,	991½	...	...	...	991½	...
Greenock,	1,686	40	...	1,401	3,127	...
Total,	36,666½	17,123	...	2,736	56,525½	...

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE V.

COD AND LING FISHERY.—ABSTRACT, showing the Total Quantity of Cod, Ling, and Hake Cured, Punched, or Branded, and Exported, year by year *in so far as brought under cognizance of Fishery Officers*, from the 10th of October 1820, when the System for Encouragement and Improvement of the Cod and Ling Fishery commenced, to the 31st of December 1883.

PERIODS.	Total Quantity of Cod, Ling, and Hake Cured.			Total Quantity of Cod, Ling, and Hake Punched or Branded.		Total Quantity of Cod, Ling, and Hake Exported.			
	Cured Dried.	Cured in Pickle.		Cured Dried.	Cured in Pickle.	Cured Dried.			Cured in Pickle.
	Cwts.	*Cwts.*	*Barrels.*	*Cwts.*	*Barrels.*	*Cwts.*	*qrs.*	*lbs.*	*Barrels.*
Period extending from 10th Oct. 1820 to 5th April 1822,	...	...	...	50,235¼	4,919½	19,578	3	,,	...
Year ended 5th April 1823,	...	...	...	54,573	3,691	19,398	3	,,	...
Year ended 5th April 1824,	...	...	...	63,590	5,437	23,098	,,	3	..
Year ended 5th April 1825,	..	...	...	52,135	3,531	14,087	2	19	...
Year ended 5th April 1826,	69,136½	3,634¾	5,621	66,315¾	5,337	7,281	1	14	...
Year ended 5th April 1827,	95,161½	9,273	9,025	82,185¾	8,008½	14,051	2	27	...
Year ended 5th April 1828,	82,515¼	6,726	6,142½	74,103¾	5,609½	13,208	2	,,	...
Year ended 5th April 1829,	81,321¼	5,786	6,819	73,500½	6,204	20,587	3	4	...
Year ended 5th April 1830,	101,914	5,652½	8,836½	92,314½	8,464	16,369	3	15	...
Year ended 5th April 1831,	37,674	...	2,950½	34,337½	2,459½	11,920	1	1	...
Year ended 5th April 1832,	50,293	...	3,779½	13,879¾	3,230	20,168	3	16	47
Year ended 5th April 1833,	58,461½	...	6,467½	13,581¼	4,393½	14,754	1	26	67
Year ended 5th April 1834,	52,710½	...	5,522½	14,255½	3,829	16,298	3	,,	24
Year ended 5th April 1835,	44,152¾	...	3,767½	9,492¼	2,235	10,632	2	24	..
Year ended 5th April 1836,	38,040	...	6,276	6,766	3,018	10,992	2	20	...

APPENDIX B.—TABLE V.—*Continued.*

PERIODS.	Total Quantity of Cod, Ling, and Hake Cured.			Total Quantity of Cod, Ling, and Hake Punched or Branded.		Total Quantity of Cod, Ling, and Hake Exported.		
	Cured Dried.	Cured in Pickle.		Cured Dried.	Cured in Pickle.	Cured Dried.		Cured in Pickle.
	Cwts.	*Cwts.*	*Barrels.*	*Cwts.*	*Barrels.*	*Cwts qrs. lbs.*		*Barrels.*
Year ended 5th April 1837,	66,892½	...	7,273	9,589½	3,206	10,195	2 11	1½
Year ended 5th April 1838,	84,996¾	...	10,303	9,259⅓	4,373	22,166	2 12	36
Year ended 5th April 1839,	85,279¾	...	10,051½	23,936½	5,093	26,701	3 ,,	150
Year ended 5th April 1840,	93,560¾	...	6,053	21,695½	3,205	29,656	1 ,,	24
Year ended 5th April 1841,	91,494¾	...	9,480	21,029¼	3,891	30,550	1 ,,	44
Year ended 5th April 1842,	76,849	...	7,038½	13,283¾	2,164	25,293	1 ,,	...
Year ended 5th April 1843,	77,207¼	...	6,431	10,030¼	1,342	23,737	3 ,,	70
Year ended 5th April 1844,	92,813½	...	5,123	20,810¼	2,226½	35,476	,, ,,	4
Period extending from 5th April 1844 to 5th Jan. 1845,	83,919	...	1,726	17,940½	229	28,815	,, ,,	20
Year ended 5th January 1846,	92,323	...	5,037	14,372½	935	29,352	,, ,,	...
Year ended 5th January 1847,	90,783¾	...	6,341½	12,387½	1,492	34,435	1 ,,	15
Year ended 5th January 1848,	86,624¼	...	6,247½	8,145¼	955	25,662	3 ,,	...
Year ended 5th January 1849,	85,463	...	6,810½	9,520	1,681	22,608	3 ,,	...
Year ended 5th January 1850,	98,903	...	6,588	15,556	997	24,154	1 ,,	20
*Year ended 5th January 1851, for Scotland and the Isle of Man only,	90,658¾	...	5,032	†...	...	22,304	1 ,,	...
Year ended 5th January 1852, for do. do.	92,083¼	...	7,019¾	...	...	17,141	2 ,,	...
Year ended 31st December 1852, for do. do.	102,976¼	...	6,886	...	...	18,994	2 ,,	...
Year ended 31st December 1853, for do. do.	105,596	...	5,122½	...	...	22,650	3 ,,	14

* The Collection of Returns for England ceased from the 5th of January 1850.

† The Punching and Branding of Cod and Ling ceased from the 5th of January 1850.

APPENDIX B.—TABLE V.—*Continued.*

PERIODS.	Total Quantity of Cod, Ling, and Hake Cured.			Total Quantity of Cod, Ling, and Hake Punched or Branded.		Total Quantity of Cod, Ling, and Hake Exported.		
	Cured Dried.	Cured in Pickle.		Cured Dried.	Cured in Pickle.	Cured Dried.		Cured in Pickle.
	Cwts.	*Cwts.*	*Barrels.*	*Cwts.*	*Barrels.*	*Cwts.* *qrs.* *lbs.*		*Barrels.*
Year ended 31st December 1854, for Scotland and the Isle of Man only,	109,684¼	...	6,166½	...	...	19,557	2 ,,	...
Year ended 31st December 1855, for do. do.	113,561¼	...	6,316½	...	...	29,154	2 ,,	25
Year ended 31st December 1856, for do. do.	110,504¾	...	6,642	...	...	29,629	3 ,,	...
Year ended 31st December 1857, for do. do.	104,668½	...	4,393½	...	...	34,310	,, ,,	...
Year ended 31st December 1858, for do. do.	95,596	...	4,584	...	.	32,152	,, ,,	...
Year ended 31st December 1859, for do. do.	118,383	...	5,362½	...	...	35,923	,, ,,	...
Year ended 31st December 1860, for do. do.	115,688	...	4,339½	...	...	32,221	,, ,,	...
Year ended 31st December 1861, for do. do.	82,344¾	...	4,145½	...	...	26,961	,, ,,	...
Year ended 31st December 1862, for do. do.	100,657½	...	7,735½	...	...	32,969	3 ,,	...
Year ended 31st December 1863, for do. do.	129,725¾	...	7,337	...	...	53,736	,, ,,	...
Year ended 31st December 1864, for do. do.	107,758¼	...	7,963½	...	...	46,461	,, ,,	...
Year ended 31st December 1865, for do. do.	112,807	...	7,678	...	...	44,928	3 ,,	...
Year ended 31st December 1866, for do. do.	115,819	...	9,957½	...	...	47,753	,, ,,	15
Year ended 31st December 1867, for do. do.	119,638¼	...	10,819	...	...	46,225	,, ,,	...
Year ended 31st December 1868, for do. do.	113,831	...	9,659	...	...	52,403	,, ,,	...
*Year ended 31st December 1869, for Scotland only,	135,585¼	...	10,319	...	...	51,864	2 ,,	...
Year ended 31st December 1870, for do.	145,288¾	...	9,945	...	...	56,400	2 ,,	...
Year ended 31st December 1871, for do.	119,030	...	9,283	...	...	54,171	1 ,,	...

* The Collection of Returns for the Isle of Man ceased from the 1st of January 1869.

APPENDIX B.—TABLE V.—*Continued.*

PERIODS.	Total Quantity of Cod, Ling, and Hake Cured.			Total Quantity of Cod, Ling, and Hake Punched or Branded.		Total Quantity of Cod, Ling, and Hake Exported.	
	Cured Dried.	Cured in Pickle.		Cured Dried.	Cured in Pickle.	Cured Dried.	Cured in Pickle.
	Cwts.	*Cwts.*	*Barrels.*	*Cwts.*	*Barrels.*	*Cwts. qrs. lbs.*	*Barrels.*
Year ended 31st December 1872, for Scotland only,	145,976½	...	11,940½	...	...	53,631 ,, ,,	...
Year ended 31st December 1873, for do.	160,716½	...	12,381½	...	...	70,101 2 ,,	...
Year ended 31st December 1874, for do.	143,466¼	...	6,754	...	...	60,913 ,, ,,	...
Year ended 31st December 1875, for do.	187,788½	...	8,503½	...	...	81,880 2 ,,	...
Year ended 31st December 1876, for do.	111,457	...	6,109	...	...	59,886 ,, ,,	...
Year ended 31st December 1877, for do.	187,200½	...	8,619½	...	...	73,368 2 ,,	...
Year ended 31st December 1878, for do.	183,809¼	...	9,219	...	...	94,969 2 ,,	...
Year ended 31st December 1879, for do.	162,365	...	8,737	...	...	78,868 2 ,,	...
Year ended 31st December 1880, for do.	155,745¼	...	7,794½	...	...	79,946 ,, ,,	...
Year ended 31st December 1881, for do.	115,513½	...	4,075½	...	...	61,426 ,, ,,	...
Year ended 31st December 1882, for do.	121,337	...	7,737	...	...	56,497 ,, ,,	2
Year ended 31st Decembe 1883, for do.	120,335¾	...	7,310	...	...	56,525 2 ,,	...

N.B.—The Books of this department do not exhibit the Total Quantity of Cod, Ling, and Hake *Cured* till the Year commencing 5th April 1825. The Bounty, from the commencement of this Abstract to the 5th April 1830, was 4s. per cwt. for Fish cured Dried, and 2s. 6d. per Barrel for Fish cured in Pickle, taken by the Crews of Vessels or Boats *not* on the Tonnage Bounty; while the Bounty for Vessels licensed for the Cod and Ling Fishery, on the *Tonnage* Bounty, was 50s. per Ton, for Tonnage and Cargo to the 5th of July 1826; 45s. from thence to the 5th of July 1827; 40s. to the 5th of July 1828, and 35s. to the 5th of April 1830, when the Bounties ceased altogether.

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary*

APPENDIX C.—(See separate Table hereto appended).

APPENDIX D.—TABLE I.

FISHERY STATISTICS.—Account of the Number of Boats, Decked and Un-decked, *irrespective* of the places to which they belong, employed in the Herring Fishery: SCOTLAND: in the Season of 1883, in a selected Week for each District; with the Number of Fishermen and Boys by whom manned; of Coopers, Gutters, Packers, and Labourers employed at the said Fishery in the Week so selected; and the Total Number of all such Fishermen and other persons so employed.

Districts where the Boats were employed at the Herring Fishery.	Boats.	Fishermen and Boys.	Coopers.	Gutters and Packers.	Labourers.	Total Persons Employed.
Eyemouth, . .	432	2,452	188	1,355	323	4,318
Leith, . . .	115	460	37	140	40	677
Anstruther, . .	239	1,434	73	350	75	1,932
Montrose, . .	174	1,160	98	655	54	1,967
Stonehaven, . .	110	688	52	324	46	1,110
Aberdeen, . .	467	3,040	175	1,696	210	5,121
Peterhead, . .	750	4,734	376	2,457	279	7,846
Fraserburgh, . .	839	5,243	406	2,723	322	8,694
Banff, . . .	182	1,082	89	615	58	1,844
Buckie, . . .	84	504	32	261	22	819
Findhorn, . .	62	399	19	186	21	625
Cromarty, . .	40	200	7	99	6	312
Helmsdale, . .	136	767	45	362	27	1,201
Lybster, . . .	138	819	41	383	35	1,278
Wick, . . .	518	3,367	239	1,782	165	5,553
Orkney Isles, . .	205	1,348	71	599	42	2,060
Shetland Isles, . .	807	5,389	382	3,003	142	8,916
Stornoway, . .	1,117	6,387	289	2,434	172	9,282
Loch Broom, . .	60	270	5	100	8	383
Loch Carron and Skye,	260	780	47	180	24	1,031
Fort William, . .	250	750	10	179	5	944
Campbeltown, . .	431	1,293	20	32	...	1,345
Inveraray, . .	261	930	6	...	62	998
Rothesay, . .	149	447	7	51	21	526
Greenock, . .	38	148	...	...	9	157
Ballantrae, . .	408	1,632	56	110	164	1,962

Fishery Board for Scotland,
Edinburgh 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX C.

FISH SOLD FRESH.—ACCOUNT, by Districts, of the Total Quantity and Estimated Value of the different kinds of White and Shell Fish taken in SCOTLAND, but excluding those Herring, Cod, and Ling accounted for *as Cured* in Appendices A and B, in the Year ended 31st March 1884, distinguishing the respective Quantities taken in each District and the Estimated Value thereof.

DISTRICTS.	Herring.		Cod.		Ling.		Tusk.		Saith.		Haddock.		Whiting.		Sprat.		Mackerel.		Turbot.		Halibut.		Sole.		Flounder.		Skate.		Other kinds of White Fish.		Total Value of White Fish.	Oysters.		Lobsters.		Mussels.		Crabs.		Other kinds of Shell Fish.		Total Value of Shell Fish.	Gross Total Value.
	Crans.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Crans.	Value.	Crans.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.		Hundreds.	Value.	Hundreds.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.			
		£		£		£		£		£		£		£		£		£		£		£		£		£		£	£		£	£		£		£		£	£	£	£
Eyemouth,	20,770	29,630	12,677	6,707	2,065	1,291	„	„	1,199	209	95,332	58,004	7,457	3,038	„	„	250	235	104	450	136	299	23	130	1,785	1,089	631	253	754	134	101,469	„	„	166	812	760	76	15,841	9,934	2,591	230	11,052	112,521
Leith,	9,936	10,801	16,284	10,849	2,797	2,395	„	„	806	204	102,666	67,369	11,632	5,098	13,102	1,037	„	„	179	460	237	631	152	248	10,854	9,112	2,752	989	7,841	2,594	111,787	1,147	783	63	309	20,920	1,569	6,196	3,151	7,860	1,198	7,010	118,797
Anstruther,	25,843	25,880	17,240	10,015	2,497	1,494	„	„	237	47	55,098	39,157	18,832	8,000	6,186	619	„	„	120	244	1,094	2,226	„	„	1,031	677	4,845	1,459	544	471	90,289	„	„	149	611	32,038	2,568	2,903	1,939	720	72	5,190	95,479
Montrose,	4,374	4,716	9,347	4,396	932	430	„	„	329	56	76,949	48,924	14,922	6,869	8,780	1,143	„	„	108	270	410	521	5	35	2,548	1,443	2,139	472	1,023	460	69,735	„	„	120	566	91,654	5,282	2,541	1,130	536	102	7,080	76,815
Stonehaven,	817	1,952	6,658	3,488	1,118	666	„	„	105	31	12,431	8,585	4,746	1,566	„	„	„	„	10	17	135	211	„	„	10	6	3,545	707	428	301	17,530	„	„	17	47	„	„	1,217	710	400	40	797	18,327
Aberdeen,	2,594	3,562	7,218	3,652	1,277	898	„	„	1,262	274	44,126	27,808	18,037	7,198	„	„	3	10	1,698	7,333	885	1,737	1,126	1,822	22,011	17,616	1,220	298	4,501	616	72,824	„	„	10	36	„	„	101	74	30	2	112	72,936
Peterhead,	1,514	1,816	9,086	3,634	5,017	2,006	„	„	8,824	1,764	22,485	13,491	4,234	1,693	„	„	30	30	291	509	1,826	3,195	20	12	450	225	2,214	553	695	347	29,275	„	„	50	376	3,200	400	152	228	137	34	1,038	30,313
Fraserburgh,	6,085	9,128	3,739	1,962	614	385	4	2	2,007	702	16,543	9,513	230	69	„	„	„	„	86	189	194	339	20	30	774	580	634	79	10,167	4,066	27,044	„	„	59	297	„	„	1,213	552	579	115	964	28,008
Banff,	4,850	5,335	6,120	3,453	1,900	1,169	20	15	556	128	20,932	14,065	298	157	„	„	5	5	76	179	298	631	104	303	3,646	2,364	590	305	340	151	28,260	„	„	39	98	„	„	688	274	„	„	372	28,632
Buckie,	788	1,020	16,900	7,602	„	„	„	„	1,683	209	37,512	22,506	3,920	980	„	„	„	„	„	„	314	314	„	„	124	74	2,491	248	34	8	32,961	„	„	9	45	„	„	„	„	186	18	68	33,024
Findhorn,	3,836	6,495	7,684	3,962	346	177	„	„	343	93	24,926	15,883	1,003	440	15,200	4,180	„	„	6	12	92	126	3	6	6,596	4,328	372	99	294	111	35,912	„	„	7	41	12,500	790	56	49	70	35	915	36,827
Cromarty,	1,013	1,529	3,808	1,699	„	„	„	„	10	3	2,941	1,805	1,505	661	160	80	„	„	4	6	„	„	6	4	1,302	646	10	3	1,500	750	7,186	3,000	1,800	12	61	52,000	2,600	474	122	4,500	450	5,033	12,219
Helmsdale,	400	570	1,168	754	4	3	„	„	130	60	1,061	400	40	10	„	„	„	„	„	„	14	26	„	„	276	138	50	15	37	29	2,005	„	„	17	108	1,593	199	20	20	249	22	349	2,354
Lybster,	1,691	2,877	1,481	506	1	1	„	„	634	104	920	422	4	1	„	„	„	„	1	1	24	18	„	„	4	3	15	7	6	1	3,941	„	„	5	28	„	„	9	6	„	„	34	3,975
Wick,	6,323	7,027	14,537	6,708	4,654	2,051	15	4	1,721	374	5,803	2,268	10	3	„	„	„	„	201	330	808	1,224	82	111	3,417	2,081	2,342	729	788	408	23,318	„	„	301	2,048	35	3	182	63	2,318	336	2,450	25,768
Orkney,	850	868	3,955	1,247	86	26	„	„	645	129	1,884	640	40	13	„	„	„	„	80	55	793	360	„	„	1,271	598	1.466	367	3,354	577	4,880	60	31	468	2,340	„	„	„	„	2,988	455	2,826	7,706
Shetland,	3,600	1,800	550	220	280	112	50	20	200	35	5,900	1,770	„	„	„	„	50	12	„	„	6,860	2,728	„	„	100	15	8,140	1,222	3,780	388	8,322	„	„	„	„	500	25	„	„	6,700	897	922	9,244
Stornoway,	3,223	5,820	4,211	1,703	2,585	1,169	369	157	5,021	888	11,356	4,739	912	280	„	„	423	423	514	288	6,353	2,350	6	3	1,971	865	25,406	3,185	9,575	1,592	23,412	„	„	2,526	9,687	2,502	160	1,113	162	4,485	715	10,724	34,136
Loch Broom,	3,182	2,022	1,465	588	407	186	„	„	2,008	402	1,450	605	527	182	„	„	„	„	„	„	390	157	5	3	277	134	583	122	830	249	4,650	„	„	629	1,964	1,048	52	„	„	1,294	150	2,166	6,816
Loch Carron and Skye,	651	843	510	510	128	152	„	„	253	63	556	278	27	13	„	„	315	236	239	289	135	163	„	„	575	431	740	185	1,670	835	3,998	„	„	1,070	5,350	„	„	289	130	3,525	440	5,920	9,918
Fort William,	764	960	1,520	751	915	423	„	„	780	340	95	92	374	390	„	„	135	231	„	„	150	67	„	„	633	289	1,040	272	866	499	4,314	„	„	349	1,554	400	40	87	7	3,494	698	2,299	6,613
Campbeltown,	6,354	12,663	1,923	1,827	609	498	„	„	1,885	698	678	685	955	995	„	„	211	439	21	61	23	37	29	72	410	347	289	127	60	12	17,961	10	6	1,095	5,121	„	„	1,042	545	778	218	5,890	23,851
Inveraray,	1,080	1,634	2,326	1,247	„	„	„	„	3,161	550	389	299	905	614	„	„	1,040	1,602	„	„	„	„	„	„	30	15	88	37	261	111	6,109	29	11	121	549	2,488	125	50	25	1,480	286	996	7,105
Rothesay,	400	598	780	383	50	26	„	„	831	312	662	602	1,480	1,489	„	„	322	495	1	1	1	1	5	6	237	219	54	23	30	14	4,169	10	5	27	202	„	„	„	„	1,335	239	446	4,615
Greenock,	833	1,591	366	381	„	„	„	„	702	273	269	319	477	567	„	„	476	844	„	„	„	„	28	35	2,131	1,594	13	4	22	17	5,625	„	„	24	127	59,715	2,497	20	13	1,420	210	2,847	8,472
Ballantrae,	3,621	8,296	4,927	3,632	411	363	„	„	320	114	604	464	1,590	1,525	„	„	1,347	1,338	163	436	24	38	88	405	4,763	3,520	839	321	533	282	20,734	2,200	770	165	589	216	162	1,194	582	1,691	3,347	5,450	26,184
Total,	114,887	149,433	184,430	81,376	28,643	15,921	458	198	35,652	8,062	543,568	340,693	94,157	41,851	43,428	7,059	4,607	5,900	3,902	11,080	21,196	17,399	1,702	3,225	67,226	48,409	62,508	12,081	49,933	15,023	757,710	6,456	3,406	7,498	32,966	281,569	16,548	35,393	19,716	49,416	10,309	82,945	840,655

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX D.—TABLE II.

FISHERY STATISTICS.—ACCOUNT of the Number and Tonnage of Boats, Decked and Undecked, employed in the Herring and other Fisheries: SCOTLAND: in the year ended 31st December 1883, with the Districts to which they belong; the Number of Fishermen and Boys by whom manned; the Number of Fish Curers, Coopers, and other Persons employed; with the estimated Value of Boats, Nets, Lines, and other Fishing Material.

DISTRICTS.	Beam Trawl Vessels.		FISHING BOATS. First Class 30 feet keel and upwards.		Second Class, from 18 to 30 feet keel.		Third Class, under 18 feet keel.		Total.		Fishermen and Boys.	Fish Curers.	Coopers.	Other Persons (*Estimated*).	Total Persons employed.	Value (*Estimated*) of— Boats.	Nets.	Lines.	Total.
	Number.	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Tons.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	£	£	£	£
Eyemouth,	1	90	288	4,857	192	1,183	87	177	568	6,307	1,518	61	188	2,721	4,488	37,622	37,394	5,942	80,958
Leith,	19	602	188	4,083	304	1,603	41	117	552	6,405	1,754	20	57	2,278	4,109	84,578	39,481	6,374	130,433
Anstruther,	1	50	585	10 322	236	1,014	100	228	922	11,614	3,826	38	77	2,332	6,273	72,470	99,152	14,202	185,824
Montrose,	1	12	195	3,977	256	1,030	195	270	647	5,289	1,279	18	98	1,762	3,157	39,555	27,183	8,392	75,130
Stonehaven,	...	...	80	1,280	50	200	69	138	199	1,618	485	31	52	854	1,422	9,115	10,334	2,828	22,277
Aberdeen,	15	1,155	121	1,936	130	780	25	50	291	3,921	979	46	175	3,716	4,916	53,435	16,916	3,467	73,818
Peterhead	1	23	325	5,850	203	1,218	155	465	684	7,556	2,668	85	378	3,910	7,041	50,090	57,023	9,372	116,485
Fraserburgh,	...	...	373	6,312	82	492	280	840	735	7,644	2,339	75	406	3,995	6,815	50,522	61,121	7,760	119,403
Banff,	...	...	281	4,215	50	300	194	582	525	5,097	1,570	39	90	1,145	2,844	21,822	23,040	4,680	49,542
Buckie,	...	...	659	11,203	40	200	146	438	845	11,841	3,960	16	62	2,838	6,876	81,340	92,260	17,081	190,681
Findhorn,	...	...	339	5,580	108	546	30	60	477	6,186	2,260	27	62	2,738	5,087	34,940	42,770	4,896	82,606
Cromarty,	...	...	131	1,881	116	461	41	90	288	2,432	923	5	14	914	1,856	8,525	24,610	2,267	35,402
Helmsdale,	...	...	127	1,651	56	291	31	82	214	2,024	776	25	48	584	1,433	7,442	12,704	1,388	21,534
Lybster,	...	...	200	3,125	13	91	19	35	232	3,251	1,258	18	41	450	1,767	12,354	16,575	953	29,882
Wick,	...	...	388	6,127	49	313	336	672	773	7,112	2,642	75	257	3,444	6,418	51,507	37,916	3,458	92,881
Orkney Isles,	...	...	168	2,407	28	206	434	942	630	3,555	2,486	30	71	936	3,523	15,697	10,726	1,907	28,330
Shetland Isles,	...	...	263	3,618	174	348	217	217	654	4,183	3,064	41	385	3,674	7,164	34,096	23,074	5,200	62,370
Stornoway,	...	...	203	3,122	419	2,817	476	1,428	1,098	7,367	4,185	33	73	3,523	7,814	34,401	25,742	9,208	69,351
Loch Broom	...	...	81	1,215	45	335	589	1,980	715	3,530	2,331	22	8	942	3,303	8,998	15,647	2,198	26,843
Loch Carron and Skye,	...	...	33	515	227	1,096	629	1,268	889	2,879	2,575	62	47	1,207	3,891	6,344	21,132	2,879	30,355
Fort William,	...	...	32	332	123	540	520	1,114	675	1,986	1,336	37	10	506	1,889	4,834	5,032	1,136	11,002
Campbeltown,	...	...	86	1,444	399	1,696	187	374	672	3,514	1,746	40	22	550	2,358	23,875	16,749	908	41,532
Inveraray,	...	...	33	582	431	2,456	235	470	699	3,508	1,557	39	7	375	1,978	15,364	17,502	1,480	34,346
Rothesay,	...	...	29	435	218	1,084	138	306	385	1,825	684	21	7	301	1,013	10,307	9,068	258	19,633
Greenock,	9	72	7	111	182	709	113	113	311	1,005	522	31	39	915	1,507	4,867	5,016	640	10,523
Ballantrae,	...	...	11	132	269	987	334	382	614	1,501	999	96	62	912	2,069	6,261	5,593	1,165	13,019
Total,	47	2,004	5,226	86,312	4,400	21,996	5,621	12,838	15,294	123,150	49,722	1,031	2,736	47,522	101,011	780,361	753,760	120,039	1,654,160

Note.—Besides the above 47 Beam Trawl Vessels—which are nearly all Steamers, and valued at £59,980—a number of the largest size of Fishing Boats occasionally engage in Beam Trawl Fishing, and these are included among the Fishing Boats in the above Table; and also the Value of Beam Trawl Nets, and of Lobster and Crab Creels are included in the Value of Nets.

Fishery Board for Scotland
Edinburgh, 2d June 1884.

DUGALD GRAHAM *Secretary.*

APPENDIX D.—TABLE III.

FISHERY STATISTICS.—ACCOUNT of the Tonnage of Shipping, and of the Number of Seamen engaged in the Trade of the Herring and Cod and Ling Fisheries: SCOTLAND: in the year ended 31st December 1883; distinguishing those employed in Importing Stave Wood, Hoops, and Salt; in Carrying Herrings or Cod Fish coastwise; or Exporting them abroad; and distinguishing British from Foreign Tonnage and Men.

DISTRICTS.	TONNAGE AND MEN.																			
	Importing Stave Wood and Hoops for the Fisheries.				Importing Salt for the Fisheries.				Carrying Herrings or Cod Fish Coastwise.				Exporting Herrings or Cod Fish.				Total.			
	British.		Foreign.		British.		Foreign.		British.		Foreign.		British.		Foreign.		British.		Foreign.	
	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.
Eyemouth,	90	7	64	4	2,231	125	56	4	1,247	86	...	...	561	34	275	15	4,129	252	395	23
Leith,	580	24	240	11	216	11	...	...	850	40	...	...	6,049	432	...	...	7,695	507	240	11
Anstruther,	141	9	1,127	64	334	19	...	...	...	...	...	...	...	...	...	...	475	28	1,127	64
Montrose,	271	16	268	18	1,668	93	...	...	28	3	...	...	1,320	60	206	10	3,287	172	474	28
Stonehaven,	...	...	...	...	556	24	...	...	...	...	...	...	350	17	296	16	906	41	296	16
Aberdeen,	7,963	485	160	9	3,408	186	...	...	1,055	70	...	...	4,548	170	1,047	51	16,974	911	1,207	60
Peterhead,	756	44	3,932	239	6,066	338	76	5	600	40	...	...	2,467	102	5,262	244	9,889	524	9,270	488
Fraserburgh,	464	22	1,686	98	5,944	323	176	9	250	20	99	5	6,193	336	9,424	478	12,851	701	11,385	590
Banff,	...	...	...	...	1,568	95	...	...	210	41	...	...	1,523	88	209	9	3,301	224	209	9
Buckie,	...	...	...	...	608	38	...	...	...	...	...	...	468	22	429	20	1,076	60	429	20
Findhorn,	...	...	...	...	76	4	...	...	...	...	...	...	198	11	...	...	274	15	...	...
Cromarty,	120	18	...	...	219	14	...	...	25	5	...	...	...	...	156	6	364	37	156	6
Helmsdale,	63	4	345	25	516	35	...	...	60	3	...	...	433	26	463	26	1,072	68	808	51
Lybster,	...	...	53	4	149	10	...	...	60	18	...	...	860	53	895	50	1,069	81	948	54
Wick,	1,447	92	4,770	315	5,212	358	183	11	1,401	119	...	...	7,243	462	5,896	314	15,303	1,031	10,849	640
Orkney Isles,	...	...	55	5	3,760	183	...	...	955	67	...	...	3,943	258	795	46	8,658	508	850	51
Shetland Isles,	184	10	152	8	11,035	602	820	41	7,500	375	...	...	16,859	1,019	6,332	279	35,578	2,006	7,304	328
Stornoway,	410	19	114	8	2,725	196	307	15	5,399	442	...	...	3,007	201	412	22	11,541	858	833	45
Loch Broom,	...	...	...	...	390	36	...	...	557	58	...	...	313	15	...	...	1,260	109	...	...
Loch Carron and Skye,	...	...	...	...	1,540	80	...	...	2,410	176	..	...	...	...	...	...	3,950	256	...	...
Fort William,	...	...	...	...	607	52	...	...	1,050	72	...	...	...	...	...	...	1,657	124	...	...
Campbeltown,	...	...	...	...	466	44	...	...	5,285	195	...	...	54	5	...	...	5,805	244	...	...
Inverary,	...	...	...	...	485	26	...	...	2,529	136	...	...	...	...	...	...	3,014	162	...	...
Rothesay,	...	...	...	...	230	19	...	...	880	68	...	...	...	...	...	...	1,110	87	...	...
Greenock,	90	6	...	...	1,610	69	...	...	1,030	53	...	...	957	51	...	...	3,687	179	...	...
Ballantrae,	...	...	...	...	137	10	...	...	...	...	...	...	50	4	...	...	187	14	...	...
Total,	12,579	756	12,966	808	51,756	2,990	1,618	85	33,381	2,087	99	5	57,396	3,366	32,097	1,586	155,112	9,199	46,780	2,484

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX D.—TABLE IV.

FISHERY STATISTICS.—ABSTRACT ACCOUNTS, showing the Tonnage of Vessels and number of Men, the Tonnage of Boats and Number of Fishermen and Boys, and the Number of other Persons employed in the Herring, Cod and Ling, and other Fisheries: SCOTLAND: in the Year ended 31st December 1883.

ABSTRACT.	Tonnage of Vessels and Number of Men.				Tonnage of Beam Trawl Vessels and Boats, and Number of Fishermen and Boys.		Number of other Persons.	Total Tonnage and Persons Employed.			
	British.		Foreign.					British.		Foreign.	
	Tons.	Men.	Tons.	Men.	Tons.	Fishermen and Boys.		Tons.	Persons.	Tons.	Persons.
Total of Herring Fishery Account, Appendix A—Table I., . .	2,035	302	...	...	...	...	...	2,035	302	...	...
Total of Cod and Ling Fishery Account, Appendix B—Table I.	2,415	526	...	...	...	...	...	2,415	526	...	...
Total of Fishery Statistics Account, Appendix D—Table II., . .	...	...	...	...	123,150	49,722	51,289	123,150	101,011	...	...
Total of Fishery Statistics Account, Appendix D—Table III., . .	155,112	9,199	46,780	2,484	...	...	...	155,112	9,199	46,780	2,484
Total, . . .	159,562	10,027	46,780	2,484	123,150	49,722	51,289	282,712	111,038	46,780	2,484

Fishery Board for Scotland,
Edinburgh, 2d June 1884.

DUGALD GRAHAM, *Secretary.*

APPENDIX E.—No. I.

HARBOUR ACCOUNTS.—ACCOUNT of the Receipt and Expenditure by the Fishery Board for Scotland for Building or Repairing Piers and Harbours in Scotland, under the Act 5th George IV. cap. 64. Year ended 31st December 1883.

Dr. *Cr.*

1882.								
December 31.	To Balance at this date,				£6,365	3	6	
1883.		*Rosehearty Harbour, Aberdeenshire.*						
January 8.	,,	Proceeds of sale of harbour plant at Rosehearty, less Bank commission on draft, 8d.,			48	10	6	
,, 18.	,,	Unexpended balance of imprests due by Inspector of Works at Rosehearty Harbour,	£5	14	5			
,, ,,	,,	Interest on Account of Inspector of Works with Union Bank of Scotland at Rosehearty,	0	9	0			
						6	3	5
		Stonehaven Harbour, Kincardineshire.						
,, 20.	,,	Contribution from Stonehaven Harbour Trust towards cost of preliminary survey of Stonehaven Harbour,				5	5	0
		Ness Harbour, Island of Lewis.						
,, 25.	,,	Contribution from Trustees of late Sir James Matheson, Bart., towards cost of erection of a harbour at Ness, Island of Lewis,				1,500	0	0
		St Andrews Harbour, Fifeshire.						
February 5.	,,	Contribution from St Andrews Pier Extension Improvement Committee towards cost of survey of St Andrews Harbour,				21	0	0
		Portknockie Harbour, Banffshire.						
March 20.	,,	Contribution from Portknockie Harbour Fund Committee towards cost of preliminary survey of Portknockie Harbour,				5	5	0
		Port Errol Harbour, Aberdeenshire.						
April 12.	,,	Contribribution from fishermen of Port Errol towards cost of preliminary survey of Port Errol Harbour,				5	5	0
		Crovie Landing Slip, Banffshire.						
,, ,,	,,	Contribution from fishermen of Crovie towards cost of preliminary survey of landing-place at Crovie,				5	5	0
		Bank Interest.						
,, ,,	,,	Bank Interest on this Account at Exchequer, year ended 31st March 1883,				54	2	7

1883.		*Stonehaven Harbour, Kincardineshire.*						
July 6.	By	Engineers' fee for preliminary survey of Stonehaven Harbour,				£10	10	0
		Portknockie Harbour, Banffshire.						
,, ,,	,,	Engineers' fee for preliminary survey of Portknockie Harbour,				10	10	0
		Port Errol Harbour, Aberdeenshire.						
,, ,,	,,	Engineers' fee for preliminary survey of Port Errol Harbour,				10	10	0
		Crovie Landing Slip, Banffshire.						
,, ,,	,,	Engineers' fee for preliminary survey of landing-place at Crovie,				10	10	0
		St Andrews Harbour, Fifeshire.						
,, ,,	,,	Engineers' fee for survey of St Andrews Harbour,				42	0	0
		Engineers.						
,, ,,	,,	Fee for report on a boat harbour refuge on the coast of Haddingtonshire and Berwickshire,				126	0	0
		Portknockie Harbour, Banffshire.						
November 9.	,,	Engineers' fee for full survey of Porktnockie Harbour,				63	0	0
		Rosehearty Harbour, Aberdeenshire.						
December 31.	,,	Payments for the harbour works at Rosehearty Harbour during the year ended this date, viz. :—						
		Works (total cost of to date £1660, 7s. 1d.),	£42	7	0			
		Engineers' fees for whole works	81	3	6			
						123	10	6

		Portknockie Harbour, Banffshire.		
June	6.	,, Contribution from Portknockie Harbour Fund Committee towards cost of full survey of Portknockie Harbour, ...	31 10 0	
		Parliamentary Grant.		
August	23.	,, Parliamentary Grant for year ending 31st March 1884, ...	3000 0 0	
		Hopeman Harbour, Elginshire.		
September	25.	,, Contribution from T. Gordon Duff, Esq., towards cost of preliminary survey of Hopeman Harbour,	5 5 0	
		Broadford Harbour, Island of Skye.		
October	4.	,, Contribution from Rev. D. Mackinnon, Broadford, towards cost of preliminary survey of Broadford Harbour, ...	7 17 6	
			£11,060 12 6	

Fishery Board for Scotland,
Edinburgh, 2nd June 1884.

		Findochty Harbour, Banffshire.		
,,	,,	,, Payments for the harbour works at Findochty during the year ended this date, viz :—		
		Works, . . .	£2,940 0 0	
		Engineers' fees, . . .	200 0 0	
		Inspector's wages, . .	165 15 4	
				3,305 15 4
		Ness Harbour, Island of Lewis.		
,,	,,	,, Payments for the harbour works at Port of Ness during the year ended this date, viz. :—		
		Works, including Inspector's wages, . . .	£2,746 6 5	
		Engineers' fees, . .	100 0 0	
		Miscellaneous, . .	8 11 0	
				2,854 17 5
		Total Expenditure,		£6,557 3 3
,,	,,	,, Balance at this date, ...		4,503 9 3
				£11,060 12 6

DUGALD GRAHAM, *Secretary.*

APPENDIX E.—No. II.

HARBOUR ACCOUNTS.—ACCOUNT of the Receipt *ex* Herring Brand Fees, and Expenditure by the Fishery Board for Scotland, for Building or Repairing Piers and Harbours, and for Telegraphic Extension to Remote Fishery Districts. Year ended 31st December 1883.

Dr. *Cr.*

1882.				
December	31.	To Balance at this date, ...		£3000 0 0
1883.				
August	23.	Parliamentary Grant for year ending 31st March 1884—		
		For building or repairing piers and harbours, . . .	£1300 0 0	
		For telegraphic extension, .	1000 0 0	
				2300 0 0
				£5300 0 0

Fishery Board for Scotland,
Edinburgh, 2nd June 1884.

1883.				
December	31.	By Balance at this date—		
		For piers and harbours, . .	£4300 0 0	
		,, Telegraphic extension, . .	1000 0 0	
				5300 0 0
				£5300 0 0

DUGALD GRAHAM, *Secretary.*

APPENDIX E.—No. III.

HARBOUR WORKS.—REPORT by the ENGINEERS upon the State of the HARBOUR WORKS in progress under the FISHERY BOARD FOR SCOTLAND—Year 1883.

We have the honour to lay before the Board the following Report on the Works of last year:—

Ness Harbour, in the Island of Lewis.—As mentioned in last year's Report, the works at Ness were begun under an experienced inspector of works in the month of February 1883, and they have been vigorously prosecuted since that date, and are now fully more than half finished. Though the unfinished works were severely tried by the exceptionally heavy gales of last winter, no damage was sustained, and should the present season prove favourable, we expect to be able to report their completion in next year's Report.

Findochty Harbour, Banffshire.—The works originally contracted for by Messrs Brand & Son are finished, and the only work now in progress is the short breakwater shown on our original design for the improvement of this harbour. This additional work was contracted for by Messrs Brand, and has now been extended to about half of its full length. The new harbour is, we believe, highly appreciated by the fishermen.

Crovie Landing Slip, Banffshire—The fishing creek at Crovie was inspected, and a design submitted for a landing slip at a cost of about £1000. This design having been approved, tenders were invited for the execution of the work, and the lowest offer, being that of Messrs Morrison & Son, Edinburgh, was accepted. The work has now been begun, and will be prosecuted to completion this season.

St Monance Harbour, Fifeshire.—The fishermen of St Monance have, unaided by any grant, erected a good harbour at a cost of about £15,000, but the funds at their disposal did not admit of the rock excavations being carried out to the extent now proposed by the fishermen, or of widening the outer entrance channel. The increased size of the boats now engaged in the fisheries, however, rendered it absolutely necessary that the rock should be at least partially excavated and the entrance improved, and these works are now being carried out by a grant in aid from the Board. The works are being executed by day's wages under an inspector, and will be carried as far as the funds at disposal will admit.

D. & T. STEVENSON,
Engineers.

EDINBURGH, *May* 28, 1884.

APPENDIX F.—No. I.

ON THE CHEMISTRY AND HISTOLOGY OF THE DIGESTIVE ORGANS OF FISHES.

By WILLIAM STIRLING, M.D., Sc.D.,

Regius Professor of the Institutes of Medicine in the University of Aberdeen.

With Plates I. and II.

INTRODUCTION.

Although the process of digestion in the alimentary canal of mammals has been studied with great care, it is remarkable that but few observations have been made upon the digestive processes in fishes, and more especially upon our common food fishes.

With the view of determining to what extent the process of digestion in fishes resembles or differs from that in man and other animals, at the request of the Scientific Investigation Committee of the Fishery Board for Scotland, I undertook some investigations at the beginning of this year upon some of our more common food fishes, such as the herring, cod, haddock, and skate. The present Report is, however, to be regarded merely as preliminary, as many difficulties stood in the way of giving anything like a complete report on so wide a subject in so short a time. The observations were commenced early in January, and were continued as opportunity afforded until the beginning of May of this year.

One of the first essentials to success in making chemical and microscopical investigations is to have *absolutely fresh material* to work upon. Now this was not always possible, as much of the fish which is landed is 'trawled' fish, which have been dead for many hours, and are therefore unsuitable for such delicate investigations. I had therefore to rely chiefly upon material that had been caught a few hours before it was subjected to examination. Another source of difficulty was that, owing to the high winds that prevailed off our coast, fresh fish suitable for my purpose were frequently not obtainable.

As the quality of fish differs greatly at different seasons, and according as the fish are or are not breeding, one would suppose that there would also be differences in their digestive organs, and also in their food under these different conditions. The fish I used were all caught off the

Aberdeenshire coast during the period specified, and most of them were at or about the time of spawning. This latter condition, I have no doubt, future researches will show, exercises an important effect on the condition of some of the digestive organs.

My original intention was to make—1. A *microscopic* examination of the alimentary canal of certain typical food fishes; and 2. A *chemical* examination of the digestive fluids, and of the digestive processes, to ascertain to what extent these differed from or resembled the digestive processes in other animals. As yet I have been able to overtake only a small part of this programme, but I think enough has been ascertained to show that the field is a most fruitful one, and one likely to yield a large harvest of useful and practical results.

PART I.

CHEMICAL INVESTIGATION OF THE DIGESTIVE PROCESSES IN FISHES.

THE HERRING.

The herring used for this purpose were as 'fresh' as could be obtained, they were taken off the Aberdeenshire coast, and were inshore or 'rock' herring. All of them contained ripe or nearly ripe milt or roe, as the case might be. The best general description of the herring is given by Professor Huxley in his lecture delivered at the National Fishery Exhibition, Norwich, April 1881, and published in *Nature* of that year, p. 607. An opening leads from the back part of the mouth between the gill rakers into the gullet, which 'passes back into a curious conical sac, 'which is commonly termed the stomach, but which has more the char-'acter of a crop.' In the following experiments this sac is referred to as the 'cardiac sac' or crop, although as a matter of fact it possesses a structure analogous to the cardiac end of the mammalian stomach. This conical sac is continued downwards into a long narrow funnel-like duct, which curves backwards upon itself, and opens into the middle of the air-bladder. This is the 'pneumatic duct.'

'Coming off from the under side (near its upper end) of the sac, and 'communicating with it by a narrow aperture, there is an elongated 'tubular organ, the walls of which are so thick and muscular that it 'might almost be compared to a gizzard. It is directed forwards, and 'opens by a narrow prominent aperture into the intestine, which runs 'straight back to the vent. Attached to the commencement of the intes-'tine there is a score or more of larger and shorter tubular organs, which 'are called the pyloric cæca. They open into the intestine, and their 'apertures may be seen on one side of it, occupying an oval space, in the 'middle of which they are arranged three in a row.'

The thick muscular gizzard-like organ is for convenience referred to in these experiments as the 'pyloric sac' or the stomach, although structurally it closely resembles the pyloric end of the mammalian stomach, at least as far as regards the epithelium covering it. A good description of the intestinal canal of the herring, accompanied by a figure, is given in the *Histoire Naturelle des Poissons*, by Cuvier and Valenciennes, vol. xx. Another figure is given in Owen's *Anatomy of Vertebrates*, vol. i. p. 20; while

there are other figures of the structure of the herring in the *Report of the Commissioner for the United States' Commission on Fish and Fisheries* for 1879. The American Report is a translation of Heincke's paper on the structure of the herring.

The most extensive experiments on the digestion of fishes is given by Krukenberg.*

Reaction of the Digestive Tract.—The digestive tract, more especially the œsophagus, crop, and stomach, are covered by a thick layer of mucus, and, unless this be removed, one is sometimes apt to mistake the reaction of these parts of the canal. The reaction of the œsophagus I have found to be neutral or alkaline, the mucous membrane of the gastric sac is usually acid, although it sometimes is neutral or even alkaline when a herring is examined with its cardiac and pyloric sacs empty, which was very frequently the case during the period I subjected the herrings to examination. During digestion the cardiac sac and its contents are always acid. The mucous membrane of the pyloric sac, covered as it is with a thick coating of mucus, is often alkaline on the surface during fasting, but during digestion when it is filled with food, or if the mucus is removed even during fasting, the mucous membrane has a distinctly acid reaction. The contents of the *pyloric cæca* are distinctly alkaline, while the contents of the gut, from where the pyloric cæca and bile duct pour their secretion into the intestine, are alkaline as far as the anus. The *liver* is alkaline in reaction, but it very soon becomes acid. The bile is feebly alkaline or neutral. Those results agree with those that obtain in man and mammals generally.

In order to test the digestive properties of each part of the intestinal canal, it is necessary to extract the various ferments (or enzymes) from the mucous membrane in which they are formed, for one cannot obtain sufficient of the digestive fluids themselves to experiment with.

Methods.

The methods I employed were those in use for the extraction of the ferments present in the mammalian digestive tract. One of the best solvents of those bodies is glycerine, and this I used extensively for extracting such ferments as are soluble in it. Besides this, I also extracted the mucous membrane with water, which removes the reserve stock of the ferment, or at least the mother-substance of the ferment, stored up within the cells which manufacture the ferments. I also subjected some parts of the intestinal tract to the action of the fluids recommended by Dr Wm. Roberts,† viz., a *boracic solution*, which contains 3 to 4 per cent. of a mixture of boracic acid and 1 part of borax; *dilute spirit*, *i.e.*, water containing 10–12 per cent. of rectified spirit; *chloroform water*, which consists of chloroform and water in the proportion of about 1 in 200. The advantage of using glycerine and these other 'extracting 'reagents' is, that a solution of the ferments is obtained which can be kept for a length of time and still retains its digestive properties. Other fluids were used for special purposes.

It was no part of my purpose to investigate the different kinds of food on which the herring feeds, but in opening the animals, necessarily a few observations on this subject were forced upon one's attention. The contents of the stomachs of herrings caught off the Aberdeenshire coast have been subjected to an extremely minute and careful analysis by Mr George Sim, and his results are to be found in his *Natural History of the Herring*. In the herring which I examined, and which contained food, this food

* Kühne's *Unteruchsungen*, vol. i.

† *On the Digestive Ferments*, by Wm. Roberts, M.D., 1880.

generally consisted of small crustacea usually in process of active disintegration. Occasionally, I found what Mr Sim also found in herrings caught in Aberdeen Bay during the years 1878, 1879, and 1880, viz., the small *Sagitta bipunctata.* One fact forced itself prominently on one's notice, viz., that one might open a large number of herrings and find nothing in their stomach. I did not examine a sufficient number to determine the number that had or had not food in their stomachs, but it was no uncommon thing to examine two dozen of herrings taken haphazard and to find that only three, four, or six had food in their stomach. There is a popular belief that the herring does not feed during the spawning season, but this I regard as a mistake, as one always finds a certain percentage of herrings with food in their stomach during January and February. This much seems certain, that they do not feed so voraciously when the ova and milt are reaching maturity, and this seems to be borne out partly by the state of the stomach and its contents, and partly by the analysis of the carbohydrates to be found in the liver. In the specimens which I examined, there was always a considerable difference in the naked eye characters of the food found in the cardiac and pyloric sacs respectively. In the former the food, if it consisted of small crustaceans, was always less digested, less compact, and the form of the animals could in most cases be made out. In the pyloric sac, which has a comparatively thick muscular coat, and is usually firmly contracted upon its contents, the food was broken up into a fine mass, and, in the case of some of the crustaceous foods, it had a reddish purple colour, due to the presence of a beautiful pigment which occurs in considerable quantity in the eyes and other parts of these animals. When the contents of the stomach were placed in alcohol, the pigment was rapidly dissolved by it. The reaction of the contents of the cardiac and pyloric sacs is acid. Sometimes a small quantity of an acid—at other times nearly neutral—fluid was found in the cardiac sac, but none was found in the pyloric sac. In the case of the cardiac sac, the food extended down quite into the lower part of its tubular continuation, which connects this organ with the swimming-bladder, but in no case does it pass along the pneumatic duct, which has an entirely different structure from the tubular, narrow, funnel-like prolongation of the cardiac sac with which it is continuous.

I subjected the contents of the cardiac and pyloric sacs to microscopic examination, and of course the result obtained varied with the nature of the food. If small fishes were present then their scales were always found undigested, and in the case of crustaceans their chitinous investments remained undigested, and I also found numerous chitinous appendages undigested in the contents of the intestine; but rarely or ever did I observe any chitinous hooks or scales in the contents of the pyloric appendages. The muscular tissue of the crustaceans is obviously rapidly digested, for it is rare to find any traces of striped muscular fibres in the intestine. As in the case of the mammalian stomach, one can generally find remains of the nuclei of cells, which, consisting as they do of nuclein, are highly indigestible. The cells of the crustaceans which contain pigment are abundant in the stomach, while the reddish purple pigment of the eyes seems to resist the digestive action of the gastric juice. In the intestine one almost invariably meets with transparent rhomboidal crystals; sometimes they are single, at other times they are in rosettes or groups. They are insoluble in ether and caustic potash, and are readily soluble in acetic acid. Entozoa are frequently to be found in the stomach, some of them moving about freely amongst the gastric contents, and others more or less firmly adherent or imbedded in the mucus covering the mucous membrane of the stomach.

There are several species in the stomach and intestine, but the investigation of the nature and affinities of these organisms requires separate study.

In order to extract the ferments, the mucous membrane of the part to be investigated was first carefully freed from all impurities or traces of food. It was afterwards minced very fine on a glass plate, and then subjected for many hours or days to the action of the solvent. In the case of glycerine, it seemed to me that a more powerful extract was obtained more rapidly by bringing the glycerine into contact with the chopped-up mucous membrane in its perfectly fresh state than when the mucous membrane was subjected to the action of absolute alcohol for twenty-four hours previously, as recommended by v. Wittich. Both extracts of the stomach were active. I made several extracts of the part of the digestive tract lying above the point where the pyloric sac leads from the cardiac sac. This part of the canal includes the œsophagus and the upper part of the cardiac sac, as can readily be determined by the microscopic structure. In extracting this part with glycerine, weak spirit, boracic solution, or chloroform, I always obtained an extract possessed of digestive properties. The ferment is obtained, not from the œsophagus, which contains no glands, but from the end of the cardiac sac continuous with the œsophagus, and lying above the aperture of exit into the pyloric sac. After the solvent had extracted the ferment, the solution so obtained was filtered in order to get a clear fluid to work with.

Having obtained a clear solution of the ferment, the next thing was to test its activity upon some substances. As is usual with experiments on artificial digestion, the ferment has to be diluted with an acid or alkaline medium, as the case may be. In the case of the extract of the cardiac and pyloric sacs, I used a solution of hydrochloric acid—2 parts of the acid in 1000 parts of water, and for the extract of the pyloric appendages I used a 1 per cent. solution of sodium carbonate.

A flake of well-washed fibrin was placed in a test-tube containing a solution of the ferment and a medium of appropriate reaction, and the mixture was exposed to a temperature of 37°–40° C. After numerous experiments, I found that the ferments of fishes, like those of mammals, are most active at this temperature, although under normal conditions they act at a much lower temperature. This observation agrees with that of Krukenberg,* who found that a temperature of 37°–40° C. was, as a general rule, most favourable for these experiments.

In all cases control experiments were made by previously boiling the solution of the ferment, which has the effect of destroying the ferments; so that in these experiments no effect was produced upon the fibrin.

The presence of a diastatic ferment was tested for in the usual way with a solution of starch, and after the mixture had been exposed for some time to a temperature of 37°–40° C., the presence or absence of sugar was ascertained in the usual way by boiling with Fehling's solution. Control experiments were also made in each case by boiling the solution supposed to contain the ferment, and testing the ferment fluid itself. There is one point in testing for the presence of minute traces of sugar which is of importance, viz., to add only a small amount of Fehling's solution; in fact, the mixture should just show the faintest tinge of blue. A trace of sugar may thus be detected which would not be observed if too much Fehling is added.

* *Untersuchungen aus dem physiologischen Institut. d. Universität, Heidelberg* (W. Kühne), vol. i. p. 329.

I made extracts of the '*cardiac sac*' or '*crop*' by means of glycerine, dilute spirit, chloroform water, and a solution of hydrochloric acid (2 per 1000). In all cases a strongly 'peptic' extract was obtained. In the case of the glycerine extract the peptic action on fibrin was obtained whether the mucous membrane was or was not previously treated with alcohol. A flake of fibrin placed in a mixture of hydrochloric acid (2 in 1000), along with a proper amount of any of the above extracts, is rapidly dissolved at a temperature of 37°–40° C., and much more slowly at the ordinary temperature of the room. When the solution of the enzym is boiled no digestion takes place. As far as my experiments go, I think the spirit extract is more powerful than that obtained by chloroform.

Instead of using fibrin as the proteid for testing the peptic action of the extract of the cardiac sac, in several cases I washed and neutralised the partially-digested contents of the crop of such herring as contained food. These contents, whether crustaceans or sagitta, were also rapidly digested. I made several experiments with other acids, such as lactic (1 per cent.), and a similar result was obtained.

It is therefore quite certain that the mucous membrane of the cardiac sac or 'crop' of the herring contains an enzym or ferment which is active in the presence of an acid medium, and this ferment is pepsin, which in all respects is identical with the pepsin of mammals. Krukenberg has ascertained that pepsin exists in the stomachs of many fishes.

The part of the cardiac sac which lies above the entrance into the so-called 'stomach,' when acted upon by similar extracting reagents, also yields pepsin. This is what one would expect from the histological characters of the mucous membrane in this situation.

The '*Pyloric sac*' or '*Stomach*,' when similarly acted upon, yielded an extract, with distinct, although feebler, peptic properties; so that it also contains pepsin. My experiments lead me to believe that the extract of the mucous membrane of the pyloric sac is not so powerful as that obtained from the cardiac sac. I have not made accurate experiments, and compared the amount and potency of the ferment (pepsin) obtained from these two organs; but simple digestive experiments show that, other things being equal, the extract of the pyloric sac does not digest fibrin so rapidly as the extract of the cardiac sac.

The Pyloric Appendages.—The uses and homologies of these organs in fishes have for long been a subject of discussion amongst naturalists and physiologists. One point is quite certain—viz., that they seem to subserve different functions in different fishes. To give a correct exposition of their functions in any one species would require more extended observations than my opportunities have afforded me. They may be either absorbing or secreting organs, or both. The question as to their absorbing function must rest upon what facilities are afforded to the chyme for entering these organs in the different species, and also upon their structure. In some fishes, as Krukenberg has pointed out, they are purely mucous glands (*Perca fluviatilis*); whilst in others they represent the pancreas, *i.e.*, they contain a 'tryptic' ferment (*Clupea sardinia*). Some of the older observers regarded the pyloric appendages as true absorbing organs, and nothing more, a view which was partly supported by Rathke,* Meckel,† and more especially by Edinger,‡ who, however, supports his view entirely from histological observations. In

* Müller's *Archiv*, 1837, p. 354. † *Anatomie Comparée.*
‡ *Archiv f. Mik. Anat.*, vol. xiii. p. 651.

some animals, as the cod, the presence of well-marked glands in the walls of these organs is so apparent as to point at once to the view that in these animals at least they are something more than absorbing organs. It is important to remember that the function of secretion does not exclude that of absorption; both functions may go on simultaneously.

The pyloric appendages of the herring, when extracted with glycerine or a 1 per cent. watery solution of sodium carbonate or spirit solution, yield an extract which has distinct tryptic properties. The glycerine extract rapidly dissolves fibrin in the presence of a 1 per cent. solution of sodium carbonate. Thus in the herring we have evidence of the existence of 'trypsin' in the pyloric appendages.

I am led to the belief that the pyloric appendages of the herring also contain a diastatic ferment. In making experiments with the tryptic ferment, one must be careful to prevent putrefaction; and this, as was pointed out by Kühne, is best done by the addition of thymol.

The Bile of the herring is a golden brown fluid, neutral or faintly alkaline reaction. Like the bile of mammals, it contains a diastatic ferment, as shown by its action upon starch. It does not act upon proteids.

The Liver.—The experiments I have made were conducted especially to ascertain the probable amount of sugar contained in this organ, and whether the amount of sugar differed according as the fish was or was not digesting at the moment it was killed. Assuming, as in the case of mammals, that any glycogen present in the liver would be converted into grape-sugar, as the fish did not reach me until several hours after their death, on making a watery extract of the liver, I naturally expected to obtain abundant evidence of the existence of sugar in the extract. The opposite was the result. In the livers of several herrings so extracted, I had great difficulty in convincing myself of the presence of sugar by means of Fehling's test. The livers I used first of all, were taken from animals shortly before the period of spawning, and whose crops and stomachs were empty. At first I was inclined to believe that the absence of food from the stomach might explain the traces of sugar in the liver, so I selected the liver of several herrings whose stomachs and crops contained food. In this case also I obtained only small quantities of sugar. The relation of the amount of sugars or glycogen in the liver of fishes to the food and other conditions is obviously one deserving of more extended examination, more especially as very variable results were obtained in the cod and skate. The fact that the roe and milt were undergoing such a great development may have influenced the amount of the carbohydrates in the liver, as it is a well-established fact that rapidly developing tissues require a larger amount of carbohydrates. Whether the carbohydrates in the liver are or are not influenced by the state of the reproductive organs of the herring, *i.e.*, whether it is in the 'matie' stage or in the full condition, when the roe and milt are rapidly enlarging and filling the abdominal cavity, and drawing upon the stored-up fatty and other tissues for pabulum to sustain their growth and development, it is quite certain that the fatty accumulations between the muscles and those around the pyloric cæca and about the intestine, gradually disappear, and the flesh becomes 'poorer.'

I trust that opportunities will occur during the ensuing season for determining these and other points.

The intestine of the herring was not subjected to examination, but this I hope to accomplish as soon as opportunity affords.

THE COD.

A glycerine, or other extract of the mucous membrane of the *stomach* of the cod, is possessed of powerful peptic properties. The gastric glands contain plenty of pepsin, and the reaction of the mucous membrane is distinctly acid. This result is what one would expect. It is no uncommon thing to find fish, such as haddock, in every stage of disintegration in the stomach of the cod. One frequently finds crustaceans, molluscs, holothurians, and sometimes great quantities of aphrodite. The aphrodite I have found very abundant in the cod's stomach during May. The calcareous coverings of the crustacea and the bones of fishes are rapidly decalcified by the gastric juice. Only the very indigestible portions of the food seem to pass unchanged through the comparatively narrow pylorus into the duodenum.

The *pyloric appendages*, when extracted with glycerine or weak spirit, yield a solution which, in the presence of a 1 per cent. solution of sodium carbonate, has distinct digestive properties, indicating the presence of trypsin. As far as my experiments go, they lead one to believe that the spirit extract is more powerful than that obtained by glycerine. Such an extract acts upon fibrin at the ordinary temperature of a room, but more rapidly at 38° C.

The Bile has a beautiful green colour, and can usually be obtained in sufficient quantities for experiments. It is neutral or very feebly alkaline in reaction. In testing for the presence of a diastatic ferment, one is apt to commit an error, unless he adopts the precaution of testing the bile itself for the presence of sugar. In one case, at least, I found that the bile of the cod contained a considerable quantity of a substance which reduced Fehling's solution, thus exhibiting the ordinary reaction for sugar. To ascertain the presence of a diastatic ferment in bile, over and above the sugar, one must of course get rid of the sugar either by dialysis or estimate the amount of sugar in a given amount of bile, and ascertain if the sugar is increased on the addition of starch. In most of the other samples of bile which I analysed, there was no sugar, but distinct evidence of a diastatic ferment.

The Liver.—Extracts were made of the liver by means of water and a solution of sulphate of soda. The results as regards the presence of glycogen and sugar varied in different specimens. In one cod's liver which I examined in this way in January, I found no glycogen, and with difficulty traces of sugar. This fish had plenty of partially-digested food in its stomach. In two other specimens examined early in May abundant evidence of glycogen was obtained. From a comparatively small piece of liver I obtained a highly opalescent solution of glycogen, after precipitating the proteids by potassio-mercuric iodide and hydrochloric acid by the method of Brücke. As in the extract of a mammal's liver, glycogen is thereafter precipitated by alcohol from the opalescent solution. The same extract showed the presence of a large amount of sugar. In this case the fish was digesting also. The difference in regard to the extracts of the liver in these two cases was certainly very great—in one no glycogen and mere traces of sugar, in the other plenty of glycogen and sugar ; while in both cases the stomach contained food, and in both cases the food consisted of crustaceans and fishes. The one fish was examined in the end of January, when the ova were large, and the others in May, when the reproductive products were shed. Obviously, a more extended analysis as to the food and other conditions must be made, before one can give a satisfactory statement as to the relation of the glycogen and sugar in

the liver, to the nature of the food, period of digestion, maturation of the reproductive products, and other conditions.

THE HADDOCK.

As in the herring and cod, the *stomach* of the haddock contains pepsin, which actively digests fibrin in the presence of dilute hydrochloric acid. I obtained a peptic extract both from the cardiac and pyloric ends of the stomach, the former being the more powerful.

The pyloric appendages, like those of the fishes just mentioned, also contain trypsin, while the bile contains a diastatic ferment.

THE SKATE.

Its stomach yields pepsin—its bile contains a diastatic ferment. From the watery extract of the liver I obtained a considerable amount of glycogen and abundant evidence of sugar. The skate is specially interesting, as it possesses a well-developed pancreas.

I have made a number of observations on the structure and functions of the pancreas, and also upon other organs which I regard as representing the pancreas in other fishes; but I hope to make this the subject of a special communication at a future period.

PART II.

HISTOLOGICAL INVESTIGATIONS ON THE DIGESTIVE ORGANS OF FISHES.

The literature regarding the structure of the intestinal tract in fishes is given in Owen's *Comparative Anatomy of the Vertebrata.* The most recent investigation upon this subject is that by Edinger—*Ueber die Schleimhaut des Fischdarmes nebst Bemerkungen zur phylogenese der Drüsen des Darmrohres.** Edinger investigated the structure of the mucous membrane of a large number of fishes. A list of the chief publications on this subject prior to Edinger's investigations are given at the commencement of his paper.

Methods of Investigation.

The tissue to be investigated was hardened by the usual methods. After making a trial of several methods, I think on the whole the best results were obtained by distending and hardening the intestinal tract in a mixture of Müller's fluid and spirit (3 : 1). Small pieces were also hardened in osmic acid ($\frac{1}{2}$–1 per cent.), and for gland texture absolute alcohol was used. In fact, all three methods were employed. For the isolation of the epithelium I used Ranvier's dilute alcohol, osmic acid ($\frac{1}{10}$ per cent.), and what I found very useful for the cells of the cardiac sac, a solution (3–5 per cent.) of ammonium or potassium sulphocyanide. The mucous membrane, when macerated for twenty-four hours in this solution, is readily broken up. The dissociated epithelial cells may then be acted upon by osmic acid (1 per cent.), which 'fixes' them, so that they may be preserved for a length of time.

THE HERRING.

The Œsophagus.

As a general rule in fishes, the mucous membrane of the œsophagus is provided with a series of permanent longitudinal folds. In the herring these folds are not so obvious as in some other fishes, such as the haddock. On examining the mucous membrane of the œsophagus from above with a low power, and by means of reflected light, one sees a number of sinuous folds with smaller secondary folds. These sinuous folds leave between them longitudinal depressions. On examining the continuation of the œsophagus into the upper part of the cardiac sac, the

* *Archiv. f. mik. Anat.*, vol. xiii. p. 651.

surface presents a series of sinuous elevations, leaving between them irregular, oval, or circular depressions which resemble 'crypts.' Into the bases of these crypts a number of tubular glands open, and practically they serve as ducts for the glands of the mucous membrane.

The œsophagus consists of a mucous, submucous, and a muscular coat, and these coats are continued on to the cardiac and pyloric sacs.

In the herring the muscular coat consists of *striped* muscular fibres, which are arranged more or less irregularly at the upper part; but at the lower part and downwards on the cardiac sac, until about where it opens into the pyloric sac, the striped muscular fibres are disposed circularly in several layers. The œsophagus is lined by cylindrical epithelium, and interspersed between these are numerous goblet cells.

Pl. I. fig. 1, shows one of the folds of mucous membrane isolated from the œsophagus. The goblet cells have small triangular cells intercalated between their upper ends. The appearance of these goblet cells when isolated is shown in fig. 2. They vary somewhat in shape, and are charged with mucus or its progenitor mucigen. When prepared with proper precautions, one can see a delicate reticulum of fibrils in their interior; while, as is usual in these cells, the nucleus, with its small mass of protoplasm surrounding it, lies quite at the base of the cell. Many of the cells have open mouths, and sometimes in stained specimens one may see a plug of mucus projecting from the cell. The extensive distribution of goblet cells in fishes was pointed out by F. E. Schulze.* The lower or attached end is long and pointed, sometimes branched. Sometimes the processes are very short. Various forms of these cells are shown in fig. 2.

The relation of the œsophagus to the upper part of the cardiac sac is best observed by making a vertical longitudinal section through the œsophagus and cardiac sac as far as the opening into the pyloric sac. The mucous membrane of the œsophagus shows the sections of the folds which give rise to a series of irregular sinuous depressions. The glands begin where the œsophagus joins the cardiac sac. At first the gland tubes are simple tubular glands, with very short tubes, several gland tubes opening into one of the crypts of the mucous membrane (fig. 3), which practically act as ducts for these tubes. Here and there between groups of the glands there are processes of connective tissue running up between the gland tubes (fig. 7). These septa are often thicker at the upper end than at the lower (fig. 7). This is also shown in fig. 5, which represents a surface section of the mucous membrane of the upper part of the cardiac sac; the section was made parallel with the surface of the mucous membrane. On one side (*a*) the crypts or mouths of the gland ducts are cut across horizontally, and the amount of connective tissue (stained red) between them is greater than at *b*, which shows the sections of the actual secretory parts of the gland tubes.

The glands are simple tubular glands, with, at first, a very short secreting portion. There does not appear to be any distinct membrana propria, and the secreting epithelium rests directly on the fine septa of connective tissue which bounds and gives form to the tubes. The tubes are lined by a *single* layer of polygonal, more or less cubical cells, resembling those in Pl. II. fig. 6. The cells resemble in form and general appearance the 'outer' cells found in the gastric glands or 'glands of the fundus' in the stomach of mammals. The cells form one continuous layer, leaving a small lumen. The shape and other characters of the cells are more fully described under 'cardiac sac.' I have failed to detect any evidence of a muscularis mucosæ in the mucous coat. Outside is the muscular coat,

* *Archiv f. Mik. Anat.*, vol. iii.

which in the œsophagus and upper part of the cardiac sac consists of striped muscular fibres disposed circularly. Under the mucous layer is a well-developed submucous coat.

The ducts of the tubes or crypts in the cardiac sac are lined by tall, narrow, columnar epithelium, the goblet cells having disappeared. These cells are practically goblet cells. Their upper parts are clear, and are filled with mucus.

The mucous membrane of the *cardiac sac* or *crop* has several well-marked longitudinal folds, running in the long axis of the conical sac. On making sections of it from where it communicates with the pyloric sac downwards into its narrow, funnel-like prolongation, one finds that the secretory parts of the gland tubes gradually become longer, while the gland ducts are more regular and somewhat longer. In the narrow conical end of the crop, the secretory part of the tubes again becomes shorter, the secretory parts being continued for a certain distance in the narrow tube. After a time they disappear, and the continuation of the tube known as the pneumatic duct is lined by a single layer of columnar epithelium.

Pl. I. fig. 3, shows a low power view of a vertical section of the crop about its middle, across one of the longitudinal folds. As a general rule, several gland tubes open into one gland duct. The gland duct is lined by a single layer of columnar epithelial cells, tall and narrow, with their upper ends open, and filled with mucus, while their nuclei are placed near the attached end of the cells. Each secretory part of the gland is simply a tubular gland, which does not seem to possess a distinct basement membrane, so that its lining secretory epithelium rests directly upon the connective tissue of the mucous membrane. Several tubes open into one duct or crypt, as shown in fig. 3. The relation of the connective tissue of the mucous membrane to the gland cells is shown in fig. 4, which represents a section across one of the longitudinal folds of the crop. The mucous coat (*sm*) sends up thin lamellæ (*ll*) of connective tissue between the gland cells (*g*), and thus forms a limiting membrane and sustentacular tissue. Fig. 5 shows a low power view of a horizontal section of the cardiac sac through the secretory part of the glands. The rounded spaces represent the divided glands, and the cells lining them are not represented. The cells lining the secretory part of the gland form a *single* row of polygonal or cubical cells. They vary somewhat in shape, as is shown in Pl. II. fig. 6, which represents several of these cells isolated. As already mentioned, they are polygonal or cubical, but there are many variations from this type; some have distinct processes (fig. 6). They are arranged one upon the other, and abut closely upon each other, so that necessarily their shape must vary. In Pl. II. fig. 3, which shows a 'scheme' of such a gastric gland, some of the cells are seen to slant upwards, and to lean upon their neighbour in an imbricate manner. The processes from some of these cells dip in between one cell and the connective tissue outside it. Each cell is usually distinctly granular in appearance, and contains a well-marked, not very large nucleus. Not unfrequently cells containing two nuclei are to be found (fig. 6). I did not discover any distinct cell-wall in these cells. The granular protoplasm certainly differs in different herrings; but my observations have not been sufficiently extensive to enable me to say whether these cells undergo the same appearances during activity and repose as are presented by the 'outer' cells of the mammalian stomach. The protoplasm sometimes contains a few globules of oil (fig. 6 *b*), whose presence is readily revealed by osmic acid.

I found that these cells resisted the action of a dissociating agent, such as potassium sulphocyanide, for a longer time than the columnar epithelium lining the crypts.

There is no distinct muscularis mucosæ. The *submucous coat* is well marked, and presents the ordinary structure. The *muscular coat* consists of a thin external longitudinal layer of non-striped muscular fibres, and a much thicker internal circular layer.

The lower narrow tubular part of the gastric sac or crop contains glands with very short secretory tubes. Two folds of mucous membrane, on opposite sides of the tube, are continued into it. These two folds seem to pursue a somewhat spiral course, and meet in the middle line, so as to divide the continuation of the tubular portion into two compartments.

Pneumatic Duct.

The pneumatic duct is the continuation of the tubular end of the gastric sac or crop, and opens into the air-bladder about its middle. Viewed from the outside, the spiral fold of mucous membrane, dividing it wholly or in part into two, can be seen. All the coats of the crop are represented in this tube, but the glands have disappeared. Pl. II. fig. 5, shows it in transverse section. Externally, *c* represents the longitudinal muscular fibres, *m* the circular. The folds have met in the middle line, so as to divide the tube into two compartments; and it will be observed that the muscular tissue takes part in the formation of the septum. Each half of the tube is lined by mucous membrane, covered by a single layer of columnar epithelium resembling that lining the crop. At first sight it appears as if one had to do with a series of branched glands, but the appearance shown in fig. 5 is due to a series of fine complex longitudinal folds in the mucous membrane. Sections of nerves and blood-vessels are seen on opposite sides, near the outer part, while at one side (*x*) the mesentery is attached. A large number of worms coiled up, so as to form circles, are often attached to the outer surface of the pneumatic duct.

There is a very striking difference, and at the same time a resemblance, between the glands of the crop of the herring's stomach and the 'glands ' of the fundus,' or those glands that lie in the cardiac and middle portions of the mammalian stomach. What strikes an observer is the remarkable resemblance between the cells lining the secretory portions of the gland tubes and the 'outer' cells in the mammalian stomach. The point of difference is that these tubes are lined by a single continuous layer of these cells. I, like Edinger, have been unable to find any layer of cells lying internal to them comparable to the 'inner' cells of mammals. Thus, these glands are simpler than those in mammals, and this perhaps is just what we might have expected. There is not yet that differentiation of tissue which is brought about by specialisation of function. Suppose the epithelial cells lining the crypts or ducts are concerned in the secretion of mucus, then it is evident that in the stomach of the herring (and in nearly all other fishes) the pepsin and the hydrochloric acid of the gastric juice must be formed within in the same cells, unless one supposes that certain of these cells secrete the hydrochloric acid and others the pepsin. This is very unlikely, so that one cell may subserve two functions, nor is there anything against this view. Looked at from the point of view of the evolutionist, one might say as yet these two functions—the secretion of an acid and the formation of a ferment—have not as yet in fishes been relegated to two distinct kinds of cells, as happens in the mammal's stomach, where one set of cells secretes the acid and another set the pepsin. One has only to recall to mind the liver cells to understand how one cell may perform several functions. Thus the liver cells not only secrete the bile, which in itself is an extremely complex fluid chemically, but these same cells form glycogen, and contain a ferment which transforms glycogen into starch.

I have no doubt that an investigation of the stomachs of a series of animals would yield data that would throw much light on the question of digestion in the higher animals. These glands of the cardiac sac appear to me to present all the characters of the 'glands of the 'fundus' of the mammalian stomach, *minus* the inner layer of cells. On this view, morphologically the so-called cardiac sac or crop would be homologous with the cardiac end and fundus of the human stomach.

The Pyloric Sac or Stomach.

By the term 'pyloric sac' or 'stomach' is meant that short tubular organ with thick muscular walls opening from the crop, and continued into the intestine. Professor Huxley speaks of it as resembling a gizzard, from the thickness of its muscular coat, which is several times thicker than the corresponding coat of the crop. Moreover, it is always firmly contracted around its contents.

The surface of the mucous membrane consists of a number of large irregular depressions, which we may regard as crypts. These crypts are deeper than those in the cardiac sac. Owing to their depth, and from their being bounded on all sides by a rampart or mucous fold, they may be regarded simply as mucous crypts or glands; sometimes they are much branched.

The pyloric sac is always lined by a very thick coating of mucus, which in hardened specimens assumes a membranous form. It lies not only on the surface, but dips down into the pyloric crypts or glands.

The structure of the mucous membrane is comparatively simple. Pl. II. fig. 1, shows a vertical section of the coats of this organ. The sub-mucous coat (*s.m.*) sends up some large folds and some smaller ones into the mucous coat, the smaller ones form the boundaries of the glands or crypts, seen here in vertical section, while glands are arranged on the sides of the larger folds. The surface of the pyloric sac and the glands or crypts are lined throughout by a single layer of tall narrow columnar epithelium, which presents all the characters of the epithelium lining the gland ducts and surface of the cardiac sac. The nucleus is placed deep in the cell, while the upper part is clear, open at the mouth, and filled with mucus. The layer of mucus which lies over the mouths of these crypts is shown in figs. 1 and 2 *l*. Not unfrequently one finds a section of an intestinal worm embedded in the mucous covering. There is no muscularis mucosæ. The circular muscular coat is very thick, while the longitudinal is thin. Fig. 2 shows an enlarged view of one of the larger folds, with its lateral secondary depressions, giving rise to the appearance of glands, many of them with branches. Structurally this organ is comparable with the pyloric end of the mammalian stomach, and the crypts seem to me to be analogous to the pyloric glands. They present much the same characters, although I did not find that the cells in the deeper part of the crypts differed in appearance from those lining the upper part of the gland or crypt.

I reserve the consideration of the structure of the other parts of the digestive tract for another occasion.

My thanks are due to Mr Couper, fishery officer at Aberdeen, for the trouble he took in selecting fish suitable for these researches.

DESCRIPTION OF THE PLATES.

Plate I. (Herring).

Fig. 1. Vertical section of three of the folds of the mucous membrane of the œsophagus, showing the columnar epithelium covering it. *a* seen from the side, while *b* represents the free ends of the cells directed towards the observer, *c* indicates the small triangular cells lying between the curved ends of the adjoining cells.

Fig. 2. *a*, Various forms of goblet cells isolated from the œsophagus. In some, the intracellular plexus of fibrils is visible, *b* columnar epithelial cells from the part where the œsophagus joins the cardiac sac.

Fig. 3. Transverse section of a fold of the mucous membrane and muscular coat of the cardiac sac or 'crop' below where it opens into the pyloric sac. It shows that several gland tubes open into one duct or crypt. Only a few of the glands are filled in. *muc*, mucous coat; *sm*, submucous coat; *m*, the two muscular coats.

Fig. 4. Section of the cardiac sac, similar to fig. 3, where the gland cells have been shaken out, leaving the connective tissue framework continuous with the submucous coat, which forms the base on which the gland cells rest. *l*, connective tissue acting the part of membrana propria; *g*, gland cells; *sm*, submucous coat; *m*, muscular coats.

Fig. 5. Surface section of the upper part of the mucous membrane of cardiac sac, just below where it is continuous with the œsophagus. At *a* the section is nearer the mucous surface, and shows sections of the depressions, crypts, or mouths of the glands (*c*) lined by columnar epithelial (goblet) cells; at *b* the section is deeper, and passes through the secretory parts of the gland tubes, the epithelium lining them being omitted. The connective tissue septa are thicker in *a* than *b*.

Fig. 6. The cells of the œsophagus, showing the small triangular cells (*a*) between adjoining goblet cells (*b*).

Fig. 7. Transverse section of the cardiac sac *above* where it opens into the pyloric sac. *muc*, the mucous coat, with several gland tubes opening into each crypt (*c*), the crypts being lined by columnar epithelium; *sm*, the submucous coat; *m*, the muscular coat, composed of *striped* muscular fibres arranged circularly.

Plate II. (Herring).

Fig. 1. Vertical section of the pyloric sac or 'stomach.' *l*, layer of mucus covering the surface; *c*, section of the crypts; *sm* and *m*, same as in other figs.

Fig. 2. Vertical section of a fold of the mucous membrane of the plyoric sac, with the branched crypts on its sides and surface. *sm* and *m*, same as in other figs.

Fig. 3. Scheme of a gland from the 'cardiac sac,' several gland tubes opening into one duct.

Fig 4. *a*, Appearance of a gland tube from the cardiac sac, with an imbricate arrangement of the cells; *b*, the lower end of the tube, showing the cells from the surface.

Fig. 5. Transverse section of the pneumatic duct beyond where the glands cease. *m*, muscular coat; *l*, outer longitudinal muscular layer; *x*, point of attachment of the mesentery; *s*, septum. The red indicates the mucous membrane much folded, giving rise to the appearance of branched glands.

Fig. 6. *a*, Various forms of gland cells isolated from the glands of the cardiac sac, some of them contain two nuclei; *b*, similar cells containing oil globules blackened by osmic acid.

Fig. 7. Surface section of the mucous membrane of the pyloric sac. *a*, longitudinal arrangement of the folds forming elongated crypts; *b*, section through a deeper part of the membrane; and *c*, deeper still, showing the more regular arrangement and smaller size of the crypts.

APPENDIX F.—No. II.

NOTE from the MARINE STATION, ST ANDREWS. By W. C. M'INTOSH, M.D., F.R.S., Professor of Civil History and Natural History in the University of St Andrews.

MARINE STATION,
ST ANDREWS, 1*st June* 1844.

A brief note only can be supplied from the station at present, since it is not yet fitted up and organised. The gas-engine, pipes, tanks, and other apparatus will, however, soon be in position.

Advantage was taken of the proximity of the station to the sea to carry sea-water, and conduct several preliminary observations on the ova of various food-fishes, and on some invertebrates. The ova of the fishes were procured for the most part from the trawling expeditions carried on for Her Majesty's Trawling Commission.

Amongst others, the ova of the cod were specially examined, and various experiments in regard to their buoyancy, the action of deleterious water (due to metallic pipes), and the effects of changes of temperature, carried on. In regard to development, the observations confirmed those so ably conducted by Professor G. O. Sars in the Norwegian waters some years ago. The effects of impure water or a very little spirit are marked—the buoyant ova at once sinking to the bottom and remaining there. All dead ova invariably sink; and as for some time little change in external or internal structure is discernible, fishermen and others may be excused for various mistakes on this head, especially when it is recollected that unripe ova also sink. There is no difficulty in hatching the ova of cod brought, for instance, from the great fishing bank (Smith Bank) off the coast of Caithness, even in jars having many dead eggs at the bottom of the water, and which remained unchanged for several days. The small size of the yolk-sac of this and other fishes shows that very soon the minute creatures must take in nourishment from without, as indeed their activity from the first indicates. The ova of the haddock and whiting were also similarly examined; but in the case of the latter, the paucity and immaturity of the males rendered most of the experiments in regard to development uncertain.

The ova of the common flounder were fertilised, and placed in the station. They are as buoyant as those of the foregoing forms. Several had been isolated for temperature-experiments in a test-tube, and heated to 98° Fahr. The ova in this instance floated about with the currents, and showed no tendency to sink; and in a few days they hatched as if nothing had happened. About a week elapses between fertilisation and extrusion from the egg. The shape of these embryos agreed with that represented by Professor Alexander Agassiz.* The movements of the young fluke in its symmetrical condition are quite different from those of the young cod or haddock.†

The ova of the grey gurnard were fertilised at sea, and developed at the station almost to the period of extrusion, when impure water again proved fatal. These appear to develop almost as rapidly as the preceding.

Other forms examined and experimented with were the long rough dab, turbot, *Cyclopterus*, *Cothus*, herring, &c.

* The colour of the pigment, which is a peculiar pale olive brown (brownish yellow by transmitted light), quite distinguishes them from the young of the gadoid fishes. The pigment-cells also seem to be less branched. In the young stages the pulsations of the apparently empty heart are interesting physiologically.

† They often hang in the water with the head either perpendicularly or obliquely downwards, slowly descend, and again wriggle upwards to repeat the descent as before.

Amongst invertebrates, again, the ova of Squids, *Natica*, whelk, nudibranchs, mussel, starfishes (*Asterias rubens*), lobster, and shore-crab were observed in process of development.

APPENDIX F.—No. III.

REPORT on the Sprat Fishing during the Winter of 1883–84. By J. Duncan Matthews, F.R.S.E., Demonstrator of Zoology in the University of Edinburgh. With Plate III.

Having been desired by the Scientific Investigation Committee of the Fishery Board for Scotland to undertake the examination of samples of fish brought ashore by the sprat fishers during the past winter, for the purpose of ascertaining to what extent young herring were intermixed with them, I utilised the opportunity thus afforded to make a comparative examination of those points in the anatomy of the sprat and young herring which serve to distinguish them from each other.

Before stating the result of my examination as to the intermixture of fish in the samples which I received, I propose to describe shortly the general appearance of the sprat (*Clupea sprattus*), and the characters which mark it off as a distinct species from the herring (*Clupea harengus*).

Although the question of whether the sprat is in itself a separate species of the Clupeidæ, or is only the young condition of the winter or autumn herring, or of both, is one which has been largely discussed; yet, notwithstanding the numerous answers in the affirmative which have been given by various observers, it is one with respect to which the opposite opinion is still largely held among fishermen and others.

The principal—generally external—characters which are peculiar to the sprat have been noticed and described by Artedi, Linnæus, Pennant, Cuvier and Valenciennes, and many others since, but certain discrepancies exist between some of these descriptions, probably to be accounted for by the small number of specimens examined; for although the sprat differs widely from the young herring, yet in some respects there occurs a considerable variation among themselves, which the examination of only a few specimens would be unlikely to disclose.

I have attempted to avoid discrepancies by the large number which I have examined, and, as a result, I have been able to verify in many respects previous observations, and also to add still further to the list of characters which not only distinguish the sprat from the young herring, but clearly prove that it forms in itself a distinct species. In all points of difference between the sprat and herring, I have verified the persistence of the specific characters in each by the examination of sixty sprats,* comparing them with an equal number of young herring, as nearly as possible of similar lengths. Besides this, I have separately examined and made a comparison of the variations existing among the sprats and herring themselves in 150 examples of each, and many of the external characters were observed in some thousands of sprats and young herring which passed through my hands for the purpose of noting the percentage present of each species. Finally, I compared what I had determined to be young herring with adult examples of both the autumn

* Taken from the Firth of Forth, but a few specimens received from Wick, Lybster, Stonehaven, and Girvan, as well as those from the Beauly Firth and Firth of Tay, were all found to be identical in every respect with them.

and winter herring, with the result of satisfying myself of their identity with these.

The result of this examination of a large number of specimens has been to show that a considerable individual variation exists among both the sprats and herring. The position of the fins on the body and with respect to each other, the length of the head as compared with total length and other external characters as stated absolutely by some observers (Parnell, Cuvier, Yarrell, Mitchell, &c.), I have found to be inconstant; and although the variation is not very large, yet it is sufficiently considerable and in such variety as to make it impossible to lay down any fixed rule on the subject. The measurements for determining these points were all made on fresh fish, laid so that the fork or shortest ray of the caudal fin was in a line with the tip of the closed lower jaw—the most anterior point of both the sprat and herring. The position of the fins, &c., being accurately marked off round the body, perpendiculars were drawn from these points to the centre line, and the measurements taken on it, this affording also at a glance a view of the relative position of fins, &c. I believe this method gives more accurate results than is got by measuring the actual distance diagonally from fin, &c., to mandible, since the slightest curvature upwards or downwards on the dead fish causes a change of these dimensions.

The variations which I have referred to, occurred not only between specimens taken from the separate samples which I received at various periods during the winter, but also among fish in the same sample, and therefore caught at the same time and place, rendering it improbable that these differences were owing to the presence of specific varieties among the sprats or young herring.

External Characters.—It is difficult to describe in words the difference which exists in the general shape of the body between a sprat and a young herring; but a short experience in observing them generally enables one at a glance to distinguish the one from the other.

The general shape of the sprat is more graceful than that of the small herring, which has not yet reached the elegant form of the adult. The body increases in depth from the head backwards for nearly one-third of the total length (about 40 mm. in a sprat 110 mm. long), this increase in depth being caused partly by the arching of the back, and partly by the curved outline of the belly, the latter, in a typical fresh specimen, being nearly equal in amount to the former. Cuvier and Valenciennes give the depth as equalling the length of head, that being one-fifth of the total length. The head varies so much in its relative length that this is not altogether accurate; but in several sprats which I selected on account of their large size the greatest depth was one-fifth of the length, including caudal rays. In the young herring, however, the greatest depth is less and nearer the head (occurring about 32 mm. from the anterior end in a fish of 110 mm. long), and the downward curve of the belly is much less. The young herring consequently has a less graceful outline, and appears to taper almost immediately from the head backwards (Plate III. figs. 1, 2). The sprat also is slightly thicker in the body than the young herring.

This thinner and more elongated appearance of the young herring as compared with an equal-sized sprat is still further increased by the dorsal surface of the head of the young herring being almost always proportionally slightly longer than the sprat's, but I believe this only applies to the comparison between sprats and *young* herring, for I find that several full-grown herring do not show a proportionally longer head than the sprat. Just as the head of the young herring is longer than the sprat's, so its operculum extends rather further back, and its most backward point is at

the extremity of the junction of the operculum with the subopercular; whilst in the sprat the posterior point of the opercular covering is formed by the operculum proper. The sprat's subopercular is slightly shorter and more triangular (Day, *British Fish*) than the herring's, and therefore the posterior point of the junction of operculum and subopercular is nearer the ventral aspect than it is in the herring.

The lower jaw in the young herring is always longer than in the sprat, and this not only in fish of the same total length, but it was found to be nearly always longer in examples where equality of length of head in sprat and herring was taken as the standard, and where, consequently, the whole length of the sprat was greater than that of the herring under comparison.

A considerable number of measurements of the diameter of the eye showed that there was but a small and inconstant difference in size in sprats and herring of similar length, the eye of the herring being, if anything, generally the larger. The eyes in both species are about the same distance from the tip of the premaxillæ, and consequently the sprat's lower jaw barely reaches the centre of the eye, while the herring's does, but the sprat's eye is if anything slightly further from the upper edge of the skull.

The position of the fins and the serrated or smooth belly is one of the oldest, as it is one of the best tests as to whether the fish under examination is a true sprat or a young herring.

In both the sprat and herring the lower edge of the belly, from the anal fin forwards, is covered by a series of peculiarly-shaped scales (Plate III., figs. 1a, 2a). These scales have a central longitudinal thickened edge or 'keel' and two lateral rays, one on each side, projecting upwards and forwards. In the sprat this central keel is stronger than is the case in the herring; and whilst in both sprat and herring the anterior end of the keel takes an elongated, pointed form (overlapped by the preceding scale), its posterior termination is very different in the two fish, its end in the sprat forming a sharp point, projecting backwards from between the two lateral rays; whilst in the herring the lateral rays, which are much more slender than those of the sprat, run down to meet in the middle line, forming an obtuse angle at the posterior end of the central keel, the sharp backward projecting point found in the sprat being absent or so slightly developed as to be scarcely visible. The flattened-out 'wings' of the scale are much larger in the sprat than in the young herring, and the lateral rays are thicker, rather shorter, and more ossified than the slender rays of the young herring's keeled scales. The rays of the sprat's scale do not form such an acute angle with the keel, and they reach it nearer its posterior point. Their forward projection in the sprat is also less, and the tendency is for the posterior sharp point of the scale to be slightly projected downwards. Although these ventral scales of the herring are altogether weaker than those of the sprat, and do not possess the sharp pointed end, they can nevertheless be felt to a certain extent, more especially between the ventral fin and the anal aperture. But although these serrations can there be felt in the herring, they are soft and harmless compared with those of the sprat. Indeed, so sharp are these scales in the sprat, that the continuous examination of sprats by the test of drawing the finger along the belly soon becomes impossible, owing to the laceration of the skin caused by the sharp spine.

In the number of these scales a considerable difference exists between the sprat and herring. The sprat has 22 or 23 (22 in a very large proportion of those examined) anterior to the ventral fin, and 11 to 13 (12

in a large proportion) from the pelvic fin to the anal aperture (Cuvier and Mitchell 33, Couch 35). In the young herring the numbers are from 26 to 29 between the head and pelvic fin, and 13 to 15 between the pelvic fin and the anal opening. The scales forming the lateral line are also more numerous in the herring than in the sprat, the herring having 56 to 58 (generally 56), and the sprat 48; while of transverse scales the herring has 16, the sprat 11 or 12.

The position of the dorsal and pelvic fins with respect to each other affords a very sure guide to the determination of the species of sprat and herring. In the sprat the pelvic fin is anterior to the first ray of the dorsal; while in the herring it is posterior to it. Wilson, in his short, and, so far as it goes, very correct definition of the sprat and young herring (*Report of the Fishery Commissioners for the year* 1866), mentions this characteristic as being less perceptible than the jagged belly, or the difference in size of the eye, whereas my conclusions, at least in respect to the latter, are the reverse. For I find the size of eye very deceptive and difficult of definition, while the position of the fins is unmistakable and certain. Although, as I have already stated, the fins vary in their position relatively to themselves, and also in their actual position on the body, the pelvic fin in the sprat varying (irrespective of the size of the fish) from 3 mm. in front of the dorsal to almost nothing, yet it is never found posterior to the dorsal, just as in the herring it is never found anterior to it, although it may vary (in the young herring) from 1·5 mm. to 5 mm. in its distance behind the dorsal.

The variation in the position of the other fins, of course within a certain rather narrow limit, is almost endless, and it is quite useless to attempt to fix their position with respect to each other so accurately as Parnell does, when he says of the herring, that the base of the ventral fin is under the sixth ray of the dorsal. Mitchell (*Hist. of Her.*) gives the position of the dorsal fin as half way between the point of the upper jaw and end of longest caudal ray, which in itself is a varying point on account of the wear and rubbing to which these rays are subjected; but whilst this was the position in which it was placed in one or two of the specimens which I examined, I found the fin generally to be situated further forward; and while unable to fix any absolute position for it, I noted that in the larger number of cases the first ray of the dorsal fin was about half way between the tip of the premaxillæ and the fork of the tail or end of the middle caudal ray, this being in accordance with Parnell's definition.

The pectoral fin is placed proportionally rather further back in the young herring than is the case in the sprat, and the centre of the dorsal is generally slightly behind the centre of the body.

The position of the dorsal fin varies much more in the sprat than in the young herring, and I found the extremes of its position on the body of the latter to lie within the extremes of its position in the sprat. The reverse, however, occurs with the anal fin, that of the herring varying more in its position, and the sprat's lying within the extreme points of the situation of this fin in the herring.

The following table of some of the measurements which I took shows the extremes of variation which were found to occur in sprats of 114 mm. ($4\frac{1}{2}$ inches) in length (including caudal rays), and in herrings of the same size. The position and length of fins, &c., given in the table are taken from the measurements of several fish; the minimum length of head for instance, in a sprat 114 mm. long, not, in fact, being found in conjunction with the minimum distance of the pectoral or other fins from the premaxillæ.

	Sprat.	Young Herring.
(*a*) Length from tip of premaxillæ to back of head (commencement of dorsal scales), . . .	mm. mm. 14 to 18	mm. mm. 17 to 20
(*b*) Length from premaxillæ to insertion of pectoral fin, ...	19 to 23	21 to 25
(*c*) Length from premaxillæ to pelvic fin, . .	50 to 52	56 to 58
(*d*) ,, from pelvic fin to first ray of dorsal, .	·5 to 3	1·5 to 5
(*e*) ,, of dorsal fin from first to last ray, . .	11 to 14	13 to 14
(*f*) ,, from pelvic fin to first ray of anal, .	20 to 21	18 to 21
(*g*) ,, of anal fin from first to last ray, . .	12 to 14	11 to 13

It will be seen from this table that although the head of the young herring may be safely said to be longer than that of a sprat of the same length of body, yet the reverse occasionally occurs (I only found one example among all those examined). For instance, a sprat 114 mm. long was measured, which had a head [see (*a*)] 18 mm. in length, while the head of a young herring of the same total length measured only 17 mm., and the same remark applies to the position of the fins on the respective fish, except always in the case of the situation of the ventral in respect to the dorsal, the former being, as I have said, invariably in the sprat in front of and in the herring behind the latter. The number of rays in the pectoral, dorsal, and anal fins is not constant in either species, but the number in the pelvic fin I have never found to change either in the sprat or herring; and as the latter has two more rays in that fin than the former, this character affords an excellent test where any doubt exists as to the species. The fin formula is as follows:—

	Sprat.	Herring.
Pectoral, . .	15 to 17 rays (generally 16)	16 to 18 rays (generally 17)
Dorsal, . .	15 to 17 ,,	17 or 18 ,,
Pelvic, . .	7 ,,	9 ,,
Anal, . . .	18 to 20 ,,	15 or 16 ,,

In both sprats and herring there are 19 caudal rays, counting only those included between the most external of the long rays. The pectoral fins are about the same size in both herrings and sprats of the same total length; the dorsal in the herring is slightly the longer; the pelvic of the herring is both longer and wider at the base than the sprats; but it is characteristic of the sprat that it has more rays and a longer base in the anal fin than the herring, consequently that fin is generally longer in the sprat than the dorsal, and scarcely so long as the dorsal in the herring.

A distinguishing character between the sprat and young herring, though rather an obscure one, is the arrangement of the teeth. These are so slight and slender, that it is sometimes difficult to satisfactorily ascertain their presence, especially if only the feeling of roughness to the touch is depended on. The teeth are arranged in the herring on the premaxillæ, maxillæ, vomers, and there is a small patch on the tongue. In the sprat they are found only on the premaxillæ and maxillæ, and the teeth on the

tongue are smaller than those of the herring, but the sprat has no vomerine teeth (Günther, Cat. of Fishes in Brit. Mus., &c.).

Dr Heincke * gives a method for determining the specific value of the external characters, and for showing how far the variations, which he found to occur largely in both sprats and herrings, are common to both. Since writing the above description I have subjected a large number of my measurements to the same test, and I find the result in many respects disagrees to a considerable extent with those of Dr Heincke. For instance, Heincke finds by his method of comparison (taking the variations in the characters of the fish as sections of a straight line) that, in the case of the keeled scales between the pelvic fin and the anal aperture, there is a tract amounting to $\frac{3}{8}$ths peculiar to the sprat alone, and a tract equal to $\frac{4}{8}$ths peculiar to the herring, whilst there is a tract amounting to $\frac{1}{8}$th common to both ('common ground of variation'). This is deduced from his having found the keeled scales to vary in number in the sprat from 9 to 12, and in the herring from 12 to 16. Now, I never found examples among the sprats which I examined of so few as 9 or even 10 keeled scales, and the maximum number was 13; nor did I ever find fewer than 13 nor more than 15 in the herring. Following, then, Dr Heincke's method, the proportions I get are $\frac{2}{8}$ths peculiar to the sprat, $\frac{2}{8}$ths peculiar to the herring, and $\frac{1}{8}$th common to both. Dr Heincke ascertained that 7 per cent. of his specimens fell within the common ground of variation. In my case, however, only 1 sprat and 1 herring out of 150 of each had 13 of these scales, so that the percentage I get, as included in the common ground, is only ·66. I get, therefore, a much smaller result, both in the amount of common ground and in the percentage of individuals included in it, and consequently the number of keeled scales appears from my figures to be of much more specific value than they are considered to be by Dr Heincke.

But this difference between his results and mine is more marked when we come to examine the pelvic (ventral) fin rays. Dr Heincke gives the number of rays (deduced from his examination of, I understand, 125 herring and 13 sprats) as 7 to 10 in the herring and as 6 to 7 in the sprat. Among over 700 sprats I did not find more or fewer than 7 rays, and in 150 young and 100 adult herrings never any other number than 9. I have, therefore, considered the number of rays in this fin as being of absolute specific value, and I would feel justified in considering the occurrence, if I had found it, of, say 1 herring with 7 rays as an abnormality, and not as vitiating my conclusions as to the absolute specific distinctness of the sprat and herring in this particular respect. In fact, the question of the specific value of a character depends altogether on the number of cases of its common occurrence in different species. Dr Heincke finds the rays in the pelvic fin to vary,—I do not, even after examination of a much larger number of specimens, and, therefore, I think his cases must be considered as very exceptional.

I still further disagree with Dr Heincke when he says that no specific value can be attached to the number of vertebræ. He has found variations in the number of vertebræ which I have not, but still I think that, even taking his figures, the smaller number, even of his maximum, in the sprat, as compared with the minimum number in the herring, justifies us in placing considerable weight on this character as one of specific value.

In some other points my results differ from those of Dr Heincke, but these principally apply to those characters which from their more common occurrence in both species, I agree with him are not of great specific importance. The following, however, are worth noting.

* 'Die Varietäten des Herings,' *Jahres. d. Com. in Kiel*, 1874–76.

Dr Heincke gives the position of the pectoral and pelvic fins as being the same in both sprat and herring. I have very many examples which show that this statement is not generally applicable to the fish examined by me.

The following table gives the various measurements of only one of these :—

TABLE showing Position and Length of Fins, &c., in a Sprat and Young Herring of 118 mm. in Length.

	SPRAT.	HERRING.
Length from tip of closed lower jaw to its articulation,	8 mm.	10·5 mm.
Length from tip of closed lower jaw to back of head (dorsal surface),	17 mm.	19·5 mm.
Length from tip of closed lower jaw to origin of pectoral fin,	21·5 mm.	23 mm.
Length from tip of closed lower jaw to first ray of dorsal fin,	55 mm.	53 mm.
Length from tip of closed lower jaw to origin of pelvic fin,	52 mm.	57·5 mm.
Length from tip of closed lower jaw to first ray of anal fin,	75 mm.	76 mm.
Length from tip of closed lower jaw to tip of longest caudal ray,	118 mm.	118 mm.
Length of base of dorsal fin,	12 mm.	12 mm.
Length of base of anal fin,	14 mm.	11·5 mm.

The table shows that both the pectoral and pelvic fins were further back in this small herring than in the sprat, and it shows that while the dorsal fin of the sprat is behind the centre of the body, that of the herring is exactly in the centre. Nearly all my other examples, however, show it to be slightly posterior to the centre of the body in the herring, differing from the position Dr Heincke found to obtain in his specimens, which was in front of the centre.

My specimens, again, did not show that the distance to the end of the branchiostegal membrane is always greater in the sprat than in the herring ; but the reverse occurred. So also with respect to a point which Dr Heincke considers very characteristic, viz., that a line drawn from the pectoral fin through the anterior lowest point of the operculum passes below the eye of the sprat, but above generally in the herring. I find, on the other hand, that this is an uncertain characteristic. The line generally runs below the eye in the sprat and above it in the herring, but among several herring 215 mm. (8½ inches) in length, as well as among small fish, I found some in which this line passed through the eye, some slightly above it, and some below.

INTERNAL STRUCTURES.—The same superiority, so far as number is concerned, which is generally shown in the fin rays, scales, &c., of the herring over those of the sprat, is seen again in a comparison of the other organs. The vertebræ number 48 in the sprat (I found one exception, that of a sprat with 47) and 56 in the herring, but, length for length, those in the sprat are rather stouter than those of the herring. As Wilson (*loc. cit.*) shows, the ribs are more numerous in the herring than in the sprat.

The gill rakers and filaments show the same difference. In the herring

the gill rakers number about 56 to 60 on the first arch, about 44 on the second, 42 on the third, and 36 on the fourth. In the sprat there are about 48 on the first arch, 44 on the second, 40 on the third, and 33 on the fourth. So with the branchial filaments there is in the herring the same preponderance of numbers over the sprat, and this applies also to the pseudo-branchial filaments, which number 14 in the sprat and about 20 in the herring. The herring has one or two branchiostegal rays more than the sprat, which has 7.

The only notable point of difference in the alimentary system consists in the number of pyloric cæca. In the sprat there are always 7 or 8 pyloric cæca; the openings from these cæca into the duodenum form a single row, the first 4 or 5, together with the very minute opening of the bile duct, being arranged round the opening from the pylorus (stomach), the remainder forming a straight row backwards. In the herring there are 18 to 24 of these cæca; they vary slightly in position, but 14 or 15 of them generally form a double row round the pyloric valve, the remainder passing backwards in a rather irregular double row. The bile duct opens in the same position as in the sprat. The stomach (crop of Huxley, *Nature*, Ap. 28, 1881) communicates posteriorly by a slender duct, about ·5 mm. in diameter, with the swim-bladder, and this duct is generally slightly shorter and thicker in the sprat than it is in the herring.

In the herring the swim-bladder is known to give off two delicate branches from its anterior end, which run forwards, one, at first, along each side of the parasphenoid, from which they afterwards diverge, and soon after enter a small oval or rather spindle-shaped capsule. From the anterior end of this capsule the duct passes out and divides into two branches; one branch runs straight forward from the spindle-shaped vesicle, the other passes outwards at nearly a right angle, and each terminates at the ear in a spherical capsule. This description applies to all the young herring which I examined. In them these ducts are very delicate tubes, measuring in a herring of 120 mm. long ·09 mm. in diameter, and are surrounded by a cartilaginous sheath of ·25 mm. external diameter. The ducts meet posteriorly in the middle line, and open by a single aperture into the narrow anterior end of the swim-bladder. The spindle-shaped capsule measures about 1 mm. long by ·6 mm. broad, and the spherical ones are about 1·3 mm. in diameter, the anterior one being slightly the larger. There is, however, a rather remarkable departure from this arrangement in the sprat. The ducts are about the same size as, and their form and direction is similar to, those in the young herring, although from the point where they diverge outwards from the parasphenoid (about 5 mm. from the swim-bladder) they lie rather higher than in the herring, and are more difficult to follow. But the duct of each side terminates in a single capsule only, similar in all respects to that of the herring, and there is neither formed on its course the spindle-shaped dilatation, nor does it give off a branch to a second vesicle, as in the herring, none such existing in the sprat. Thus, while in the herring there are three vesicles on each side of the head, all containing air, in the sprat there is only one (Plate III., figs. 3, 4, and 5).

While these characters are so numerous, and so constant at all seasons, that there can be no question as to the sprat being a distinct species from the herring, a further proof is to be found in the fact that the former is found with developed milt and roe. During the winter months the reproductive organs of the sprat and young herring which I received could not be distinguished from each other; but about March it was noticed that in a small proportion of the sprats the milt and roe were increasing in size, the former showing the ova scattered more or less

closely throughout, and the latter becoming whiter in colour and larger. Unfortunately, just at this time, the most interesting and important period so far as regards the elucidation of the habits and development of the sprat, the fishing ceased, and there could no longer be procured those regular supplies which were essential for the further working out of this question.

Of the few sprats, however, which continued occasionally to be received, it was noticed that the ripeness of the roe and milt continued to increase, until now, early in June, the comparatively small number which are sent, both from the East Coast (Stonehaven), West Coast (Girvan), and the Firth of Forth, are almost invariably 'full,' many being so ripe as to enable the roe to be readily expressed by hand, presenting much the same appearance (Plate III. fig. 6) as is presented by that of the adult herring under similar circumstances (Ewart, *Proc. Roy. Soc.*, 1884). In not a single instance has this condition of the roe or milt, or even the slightest appearance of increasing maturity, been found in those fish which were identified as young herring, all those procured at this time, even up to 8 inches long, being always immature.

So far as the ripeness and consequent spawning of the sprat is concerned, the specimens which I have seen show it to take place almost entirely in May and June, and this is in accordance with Couch's statement on the subject. Day (*Land and Water*, March 1884) mentions having received sprats in a breeding condition from Cornwall in December and January; and Sim (Prize Essays of International Fisheries Exhibition, Edinburgh, 1882) states that 'many sprats caught about the month 'of December will be found with milt and roe far advanced towards 'maturity—that is, in sprats of $5\frac{1}{2}$ inches long the milt and roe are almost 'fully developed;' but of the hundreds from the Firth of Forth, and also many from the Tay, which I have examined for roe or milt, nothing approaching maturity was to be found till near the end of March, and not a ripe or nearly ripe fish was procured till May.* It is possible that this depends on the locality; and if the suggestion that the sprats seek deep water for spawning purposes is true, the absence of ripening roe and milt among my winter specimens, nearly all of which came from the Firth of Forth, might be accounted for. It is improbable, however, that none in this condition should have been caught even on their way to deeper waters, and I believe it will be found that examples of ripe winter sprats are exceptional on our east coast of Scotland.

Yarrell gives the length of a full-sized sprat as 6 inches, but Couch gives a much nearer approach to the truth, stating that it may be 5 or 6 inches long, but that the usual size is 3 to 4 inches. Of the sprats received from the Forth fishings only one measured 6 inches (152 mm.), only two or three $5\frac{1}{2}$ inches, the usual length of what appeared to be full-grown sprats, and all those near maturity being 4 to $4\frac{1}{2}$ inches (110 mm.). The smallest which I received was $1\frac{3}{4}$ inches (45 mm.) long, and fish of this size were selling as 'whitebait.'

I think it will be seen that, from the above description of the sprat and young herring, there should be no difficulty in any one determining which is which, even after a cursory external examination alone, for where one peculiar characteristic happens to be obscure, some others are always sure to be apparent, which should enable any one to avoid the difficulty of one of the Fishery officers, who lately forwarded a small fish with the remark (without stating the grounds of his belief) that he would like to call attention to it, as 'it has serrated belly same as a sprat, but is

* This appears to be the case in the Moray Firth also, for Mr Murray, fishery officer at Stonehaven, writes that when stationed at Burghead he frequently saw sprats ready to spawn in May and June.

' unquestionably a young herring.' An examination of the fish referred to showed that it was unquestionably a sprat, every one of the distinguishing marks of the species being present.*

The Sprat Fishing.—Ever since the sprat fishing originated (about 1836), the question of what amount of damage, if any, is done to the herring supply of our coasts by the taking of young and immature herrings has often been discussed. It has been stated and restated, only to be again and again denied, that enormous numbers of young herring are annually destroyed during the period over which the sprat fishing extends, they being mixed with the sprat shoals, and of course netted with them; the supply of adult herring being as a consequence much diminished, not only by the actual numbers thus early destroyed, which is a comparatively small matter, but by robbing the sea of what otherwise might, by living to deposit their spawn, become the progenitors of an always increasing future supply.

But how far our national herring supply is affected, owing to the take of small herring by the sprat fishers, is a subject which, with our present limited knowledge of the life history of the herring, may receive many interpretations, since it depends altogether on the quantity of these young fish, which would be likely to escape the many risks of their life, and on reaching maturity deposit their spawn. I am not to attempt here a reply to this question, but am simply to state the probable take of young herring during the past winter, as data from which the Fishery Board may draw its conclusions.

In their Report to the Commissioners for the British White Herring Fisheries, on the Sprat Fishing of the Firth of Forth in 1861, Dr Lyon Playfair, C.B., and Vice-Admiral Dundas state that the proportion of young herring to sprats was at that time 1 in 100, and they explain that generally the shoals of sprats and young herrings do not intermix (except under certain conditions, such as a heavy tide in conjunction with a gale of wind, or towards the end of February when the sprats go lower down), the young herring preferring deeper water, and keeping to the rear or east of the sprats. What information or observations this opinion is founded on I do not know, but if it is the case, it will readily be understood why great variations occur in the proportions of young herring to sprats after different fishings, even in the same locality and especially in different seasons.

The weather no doubt influences much the locality of the sprat fishings. In the Report referred to, it is stated that from November to the end of February the sprats come into the shallows of the Firth of Forth, liking brackish water at this season, and that rarely are they fished as low as Aberdour and Burntisland. This year, however, the shoals of sprats for a long period frequented the Firth about Burntisland and lower down. Many of the samples procured for me were taken off Burntisland, and a large proportion of the whole were taken off or below Aberdour, and this occurred during the months of November, December, and January, as well as later. We are, however, in almost entire ignorance of the habits, migrations, food, &c., of the sprat. Whether the shoals of sprats and young herring really do keep in general apart; the reason for the sprats entering these estuaries (the ill success with which I examined sprats' stomachs for food seems rather to be against the theory that they pass into the brackish waters in search of it, the stomachs being invariably quite empty, except two or three sent from Stonehaven and Wick, which contained crustacea, principally *Temora*); and their development, are subjects which have yet to be investigated.

* It may be worth mentioning that while throughout the winter from 1 to 6 per cent. of the sprats in the samples had from one to four of the parasitic *Lerneonema* fixed to their eyes or fins, not a single case of its presence on a young herring was found.

The samples of small fish which were examined, were procured partly direct from the boats, partly from fishmongers' shops in Edinburgh, and several were sent by the commander of the F.C. 'Vigilant,' and by the Fishery officers.

The result of the examination went to show that there was scarcely any intermixture of young herring with sprats in the samples sent from Inverness, the fish in which had been caught in the Moray Firth, but these samples were too few, and did not contain a sufficient number of fish to permit of sure conclusions being drawn from them. The samples, eleven in number, were taken in November, December, and January, and showed a very small percentage of young herring (·6 per cent.) to sprats; but two small samples sent up by the Fishery officer, as caught off Redcastle, Beauly Firth, and landed at Inverness, in December and January, contained 68 sprats and 12 young herrings (15 per cent.), all between $3\frac{1}{4}$ and $5\frac{1}{2}$ inches long; and if the evidence of these few samples is to be trusted, it would seem that there is much more intermixture of sprats and young herring in the Beauly Firth than in the more open Moray Firth.

The samples from the estuary of the Tay, caught by bag-net, show the largest percentage of herrings to sprats among all those examined. Of ten Tay samples procured by Captain M'Donald on different occasions during the month of November last, and containing 503 fish, there was an admixture of 106 herrings (over 21 per cent.), all between $3\frac{1}{4}$ and $5\frac{1}{2}$ inches long. The district Fishery officer sent up four samples during December, consisting of 154 fish, of which 54 (fully 35 per cent.) were young herring. In January he sent a sample containing 132 fish, 4 (fully 3 per cent.) being young herring. In February four samples were forwarded, containing 266 fish, 65 (24·4 per cent.) being small herring. And in March two samples arrived, with 117 fish, of which 19 (16·2 per cent.) were herring, giving a total of 1172 fish examined, 248 or over 21 per cent. of which were small herrings. The percentages in the various samples varied from 3 to 80.

Mr Miller, Fishery Officer, wrote on 13th December, that 'since 1st 'October over 400 tons of these fish have been landed at Dundee, from fish-'ings between mouth of Tay and Invergowrie Bay (about 14 miles up), and 'sold for manure at 16s. to 17s. per ton.' He also sent specimens of herring from 6 to 8 inches long, of which he wrote the boats contained from $\frac{1}{4}$ to 5 crans, these herring being caught in drift nets, few or no sprats being taken among them. These fish were all immature. On various other occasions, however, he sent herrings of this size, with the remark that the boats contained about 1 of these fish to every 40 small.

It would appear, therefore, that while a considerable percentage of small (under 5 inches) herring are mixed with the sprats caught by bag net in the Tay, there is also a considerable quantity of larger herrings (over 6 inches) taken along with them, as well as by the drift nets.

Of the Firth of Forth samples, one came from Anstruther, and contained 72 fish, 62 being sprats, 10 small herring (*i.e.*, $5\frac{1}{2}$ inches or under)—a percentage of nearly 14.

There was bought from fishmongers' shops in Edinburgh, on four days of November, samples containing 394 fish, which on examination proved to consist of 375 sprats and 19 herrings (over 4·8 per cent.), all of which measured from $3\frac{1}{2}$ to 5 inches long, the percentage of herrings to sprats varying on different days from 0 to 16. On seventeen occasions in December 1642 fish were bought, among which were 140 herrings (over 8·5 per cent.). The percentage varied in these samples from 0 to 60. In January ten samples were procured, containing 1263 fish, 1231 being sprats and 32 herring (over 2·5 per cent.); the lowest percentage being *nil*, the highest 9·5. In February twelve samples were examined,

giving a total of 1151 fish, 43 (over 3·7 per cent.) of which were herring, with a rate of from 0 to 13 per cent. Four samples were procured from the shops in March, there being 427 fish, with an intermixture of 19 (nearly 4·5 per cent.) herring, the percentage of the latter varying in the samples from 0 to 7. A total of 4877 fish, with a percentage of 5·18 herrings. It will be noticed that of these fish, bought as sprats in the Edinburgh shops, the proportion of young herring to sprats varies much, there being sometimes as many as 60 herrings to 100 sprats, on other occasions there being none. All these fish were from $3\frac{1}{4}$ to $5\frac{3}{4}$ inches long; but as the boats were certainly bringing in greater or less quantities of larger herring (6 to $8\frac{1}{2}$ inches), it is probable that these, as fetching a higher price, had been separated, when in any quantity, from the small fish, consequently, the above percentages may be rather under the mark of the total number of herring netted with the sprats. The figures, however, show the proportion in which young herring were sold as sprats in the Edinburgh shops during last winter.

The samples taken directly from the boats (circle net fishing), were removed by the spade as chance directed, while the boat was delivering its take.

Thirteen samples were taken during December, the total number of fish being 1671, of which 215 (over 12·8 per cent.) were herrings from $3\frac{1}{4}$ to $5\frac{1}{4}$ inches long, the percentage of the different samples ranging from 1·5 to 76·4. In January seven samples were got from the boats, containing a total of 874 fish, among which were 56 (6·4 per cent.) young herring, the percentage of the latter ranging from ·8 in one sample to 15·2 in another. In February four samples were procured, these consisting of 591 fish, 15 of which (2·5 per cent.) were herring from $3\frac{1}{2}$ to $5\frac{3}{4}$ inches long, the lowest percentage being ·7, the highest 4·3. A total of 3136 fish, with a percentage of 9·1 herrings. Most of these fish had been caught off Aberdour, some off Burntisland and neighbouring places; and the take of the boats, from which the samples were procured, varied from 20 to 62 barrels, generally being about 45 or 48. It will be seen from the figures that great fluctuations occur in the amount of intermixture of sprats and herrings both in the Tay and Forth, though this is more marked in the latter, where often no herring are mixed with the sprats, a circumstance which I have never found to occur in the Tay samples. I am unable however to explain the cause of these changes in the amount of intermixture, for in cases where the contrasts exist the fish had been caught in the same locality, and in similar weather, though on different days.

It may be assumed that practically all the fish which were bought in Edinburgh shops as sprats, were caught in the Firth of Forth. The number of days, therefore, on which samples of the Forth fishings were procured for examination was in November (latter part only) 4, in December 20, in January 15, in February 15, and in March (early part only) 4. So that samples of the fishing on about every second day during the winter were examined, and the result of these examinations may be taken as a fair criterion of the quantity of young herring taken from the Firth of Forth along with sprats. As was stated in connection with the Tay fishery, however, this by no means gives the total quantity of immature herring caught, for the drift-net fishers (and circle-net to a certain extent), were bringing in herrings of 6 to $8\frac{1}{2}$ inches long, and, although my examination was not specially extended to these, such of them as I did receive all proved to be immature.

The result of the examination of all these samples, amounting to 9515 fish, is to show that last winter in the Moray Firth, less than 1 per cent. of young herring were taken by the sprat fishers; in the Beauly Firth 15 per cent.; in the Firth of Tay over 21 per cent.; and in the Firth of

Forth 6·78 per cent. The heaviest percentage is found in the Firth of Tay; but I am not prepared to say this is owing to the bag-nets, but probably is due to the more confined waters creating a nearer approximation, and consequent mixture of the shoals of sprats and young herrings, and this is borne out again by the Beauly Firth returns.

Mr Reiach, Inspector of Fisheries, has ascertained for me that 30,000 sprats go to a cran, and has supplied me with the total take of so-called sprats from the Firths of Forth and Tay, and the Moray Firth.

The total quantity caught during last winter in the Firth of Tay amounted to 14,966 crans, of which there were sold as manure 14,646 crans, and as fresh fish 320 crans. The percentage of herrings which I found to be present in the Tay samples was over 21 per cent.; of the whole take then, we may conclude that 3075 crans, representing in numbers 92,250,000 young herring, were sold as manure, and 67 crans, equal to more than 2,000,000 as fresh fish.

The returns for the Moray Firth are 15,360 crans, 11,860 of which were sold as fresh fish, and 3500 as bait. This is equivalent (including the Beauly Firth, which is in this district) to 593 crans or 17,790,000, young herring sold fresh, and 175 crans, equal to 5,250,000 young herrings sold for bait.

The total take in the Firth of Forth amounts to 13,102 crans, 8790 of which were sold as manure, and 4312 as fresh fish. The percentage of young herrings taken here is over 6·7; so that 590 crans, containing 17,700,000 young herring, were sold as manure, and 290 crans, with 8,700,000 herring, were sold as fresh.

This gives a total for the three firths of 143,690,000 young herring taken during the winter months, equalling, if allowed to reach maturity, about 160,000 crans.

EXPLANATION OF PLATE.

Fig. 1.—Outline of large Sprat 130 mm. long, full size.

Fig. 1ª.—Keeled scale of Sprat, seen from ventral surface, and slightly flattened, ×4. *a*, posterior point.

Fig. 2.—Outline of young Herring 130 mm. long, full size.

Fig. 2ª.—Keeled scale from young Herring, seen from ventral surface, and slightly flattened, ×4. *a*, posterior point

Fig. 3.—Anterior end of swim-bladder, ducts, vesicles, &c. removed from head of Sprat, ×4.

Fig. 4.—Anterior end of swim-bladder, ducts, vesicles, &c. removed from head of young Herring, ×4.

Fig. 5.—Optical longitudinal section of anterior end of swim-bladder and part of duct, &c., of Sprat, ×26, outer silvery coating removed.

Fig. 6.—Ova of Sprat (expressed in June 1884), nat. size.

Fig. 6ª.—Ova of Herring, nat. size.

APPENDIX F.—No. IV.

NATURAL HISTORY OF THE HERRING. By J. Cossar Ewart, M.D., Regius Professor of Natural History in the University of Edinburgh, and Convener of the Scientific Investigation Committee of the Fishery Board for Scotland. With Plates IV.–IX.

I.

VARIETIES OF THE HERRING.

It has been long believed by fishermen and others who are engaged in the fishery industry that there are several varieties of the herring, and that it is not only possible to distinguish autumn herring taken off the coast of England from those taken off the coast of Norway or around the Shetland Islands, but that a herring taken off Wick can be readily distinguished from a herring caught near Peterhead or Fraserburgh; and further, that these autumn herring are different from the 'rock' herring found inshore during the winter.

From recent investigations made by the German Commission,* it appears that the spring herring of the Baltic differs from the autumn herring of the North Sea, the essential difference consisting in the position of the dorsal and pelvic fins, and in the length of the operculum.

Boeck and Fiddersen,† after comparing the spring and autumn herring, came to the conclusion that there is no structural difference between them; and Ljungman,† after studying the spring, autumn, and wandering herring found on the coast of Sweden, was unable to satisfy himself that they were distinct forms.

It is easily understanding how several varieties of herring might arise. If we suppose that herring were at the outset littoral forms, it is conceivable that some of their descendants would naturally remain inshore throughout the year; that others would wander seawards, and only return to their ancestral home once a year to spawn; while others might be modified so as to prefer living always at sea,—depositing their spawn in deep water far from shore. As a result of the different surroundings, it might be supposed that slight alterations, especially in the form of the body and of the fins, would arise so as to produce at least two distinct varieties. Whether this has taken place has not yet been determined. Specimens of herring from nearly all the fishing stations around the coast have been examined during the winter and spring, but it has been impossible to arrive at any definite conclusion. Over 500 of the specimens have been carefully drawn on sheets of paper, and in each instance the position of the various fins, the length of the operculum, &c., indicated. A comparison of the outlines shows not so much that the herring of one district, say Anstruther, differ from those of another, say Ballantrae, but that there is a remarkable variation amongst the herring of the same district, very often a variation amongst the herring caught at the same time. Heincke considers the position of the dorsal and pelvic fins of great importance in determining the varieties of the herring, and by means of drawings, endeavours to prove that the dorsal fin is always further from the tip of the snout in the autumn than in the spring herring. From the specimens already examined, I have found that there is even more variation between two spring herring of the same absolute length, caught at the same place, and as nearly as possible at the same stage of maturity, than Heincke finds between his

* Heincke, 'Die Varietäten des Herings,' *Jahresbericht der Commission in Keil für* 1876–78.

† United States Commission Report, 1873–75.

autumn and spring herring. This difference is illustrated by figs. 2 and 3, Pl. IV., which represent two ripe male spring herring taken at Anstruther. A somewhat different and even more marked variation is seen in figs. 1 and 2, Pl. V., which represent two spring herring sent on the 28th March from Girvan, the one a full herring, which weighed 12 ounces, and measured 13 inches in length, while the other represents a spent herring of the same length. In the full herring, the dorsal fin is situated further back, and the ventral fin slightly further forward than in the spent herring.

The same variations occur amongst the autumn herring, so that unless some better distinction than the position of the fins is discovered, it will be difficult to distinguish, by structural characters, a spring from an autumn herring, and the same difficulty is likely to arise in endeavouring to distinguish between a west and an east coast herring. At first it was difficult to account for herring spawning twice a year—in the spring and in the autumn. Some believe that the herring which spawn in March spawn again in September, but this is very unlikely. It is more probable that the shoals which spawned last spring will not spawn again until next spring, and that the shoals which spawned last antumn will spawn again for the first time next autumn. If this is so, how is it possible to account for the appearance of two distinct races of herring? We may suppose that at first all herring were in the habit of spawning about the same period—it may have been in autumn or in spring—but that as time went on, probably as the result of variations, herring were found spawning during each month of the year.

As an indication of this, we have had specimens of herring ova sent almost every week from the Aberdeenshire coast during the winter; this shows that herring have been spawning in one district without interruption for at least ten months—from August 1883 to June 1884.

Granting that herring spawn all the year round, we can, I think, easily understand why at the present day there are two great spawning periods every year. The explanation is not, as has generally been supposed, that spring and autumn are the best seasons for the depositing and hatching of the eggs, but rather that spring and autumn are the two most favourable periods for the appearance of the fry. During my first visit to the Ballantrae Bank in March, I was struck by the almost complete absence of surface forms, while I was equally impressed during my second visit a fortnight later with their immense numbers. Now the number of individuals of any given species does not depend so much on the number of eggs formed as (1) on the number of eggs successfully hatched, and (2) on the number of fry that survive. In the case of the herring the number seems chiefly to depend on the survival of the fry. This conclusion has been arrived at because nearly all of the many millions of eggs I have dredged had been fertilised—generally they contained active embryos—and because the fry when hatched are at first effectively protected by their minute size and great transparency; hence given sufficient food, they are likely to pass safely through the larval stages at least. If in spring and autumn this larval food is more abundant than at other times, it will be evident that in course of time more fry would survive in spring and autumn than during any other months, and this continuing generation after generation, enormous shoals of spring and autumn herring would be formed.

II.

THE MIGRATION OF THE HERRING.

More has probably been written on the migration of the herring than on any other fish problem, but, as a matter of fact, we, at the present

moment know next to nothing, either of the extent or of the causes of migration.

Before the migration of the herring can be understood, it will be necessary (1) to make an exhaustive examination of their food, and to discover what physical conditions influence the movements of the shoals of crustacea and other forms which serve as food; (2) to determine how the various varieties of herring (should any exist) may be distinguished from each other; (3) to study further the influences which guide the herring in selecting a spawning ground; and (4) to ascertain how far the movements of the herring are modified by storms, temperature, currents, and other physical conditions.

We may, in the meantime, suppose that herring are regulated in their movements during the greater part of the year by the supply of food, and that during the rest of the year they are under the influence of what may be known as their spawning instinct.

If we take as an example the Ballantrae herring, we may suppose that after the spawning is over they leave the coast and begin to feed, and that, though directly influenced to a certain extent by the temperature, storms, and other physical changes, their movements are almost entirely determined by the movements of the crustacea and other minute creatures on which they feed. Storms and increased surface temperature will probably only lead them to seek stiller and deeper water, for it is believed that they not only avoid the light, but also that they prefer a low to a high temperature, while the currents which sweep along the shoals of mysis and other crustacea may lead the herring at one time towards the west coast of Ireland, at another towards the Outer Hebrides, or it may be into the upper waters of the Firth of Clyde. There is, however, no evidence that the herring which spawn on the Ballantrae Bank in spring frequent Lochfyne and its neighbourhood during the rest of the year. While moving hither and thither in the wake of their food supply, we know that their condition rapidly improves, and that they soon begin to store up fat in their muscles along the sides of the intestine and in the lobes of the liver. During all this time their movements are naturally very inconstant, so that when the fishing of any district depends on the arrival of herring in search of food, it is likely to be subject to great fluctuation. In course of time, some nine or ten months apparently after the last spawning period, a sufficient supply of nourishment having been stored up, the influence of the spawning instinct begins to assert itself, and to a great extent to overcome all other tendencies.

The spawning instinct seems to imply several things, but it specially leads the herring to select ground suitable for the deposit of the eggs and waters having a suitable depth and temperature, which will provide an abundant supply of food for the young fry.

Ljungman found that herring when under the influence of the spawning instinct (which one may suppose has been elaborated through the influence of natural selection) moved towards the inshore banks on the coast of Sweden along valleys at the bottom of the sea. If this is so, we may suppose that, unless there is a very strong instinctive desire to return to their birthplace as the coast is approached, the main shoal breaks up into divisions which select all the available inshore banks. It is conceivable that, while nearing the coast in this way, a great storm might break up and scatter the shoal, and carry the herring to other parts of the coast, and thus lead to the desertion of the usual spawning ground, or that, even although the eggs were safely deposited, owing to the appearance of cold Arctic currents, the temperature might be reduced below the point suitable for their development. Further, overcrowding on the bank, or the great destruction of spawn or of spawning herring, might also lead

to a diminution of herring in future years. How long the herring frequent the banks before they spawn is not known—some say two months. In all probability they all begin to seek the spawning grounds about the same time, but the length of stay will depend partly on their condition on arrival, and partly on the temperature of the water, for the rate at which the roe and milt ripen is greatly influenced by the amount of food stored up, and by the surrounding temperature. This being the case, the fishing of any season is likely to depend to a certain extent on the temperature, for when high the herring will soon mature, spawn, and leave the coast; while when low the roe and milt will ripen more slowly, and this will lead not only to the individual herring remaining longer, but also to a greater crowding on or near the spawning ground at the same time. This may account for the takes being greater during a season with a prevailing low temperature than when there is an average high temperature.

Widegren mentions that the spawning process only occupies about six hours, but although I have spawned hundreds of herrings, some of them half spent before taken, I have never succeeded in expressing either all the eggs or all the milt, so that it may be inferred that herring remain several days on the bank after spawning actually begins. The time occupied in spawning is referred to in a paper * which, with the permission of the Scottish Fishery Board, was communicated to the Royal Society in March last. In this paper the spawning is referred to as follows :—

'When at Ballantrae I noticed that the trammel-nets secured often more 'males than females. Is this partly owing to the males swimming some-'what higher than the females, and partly owing to the males taking 'longer to shed their milt, and hence remaining longer on the spawning-'ground? It may be found that while the females discharge all their 'spawn in three or four days, the males require nearly double that time to 'get rid of their milt. Mr Wilson, fishery officer at Girvan, at my request, 'made a number of experiments with ripe herring. He found that on 'opening a female herring, after as much spawn as possible had been ex-'pressed by the hand, about a fourth of the roe remained, while on press-'ing a ripe male in the same way about a third of the milt remained, and 'he observed that it was more difficult to express the milt than the roe. 'Mr Wilson states, in answer to other queries—(1) that the ripest fish are 'caught in the trammel-nets, while most of the unripe fish are obtained 'in the drift-nets; (2) that at the end of the fishing season there are 'about three males taken for every two females, indicating not necessarily 'that the males are more abundant than the females, but rather that the 'males remain longer on the spawning ground; and Mr Wilson believes 'that herring prefer quiet water free from strong currents when spawning, 'and that when the weather is fine the herring remain long upon the 'bank and deposit their spawn leisurely, but when there are strong cur-'rents, they either hurry the spawning process or disappear into deeper water.'

III.

THE SPAWNING GROUND.

It has long been known that herring were wont to spawn on hard ground, and this was placed beyond doubt by the investigation instituted by the Fishery Board in 1862–63. From a very complete survey of the Ballantrae Bank it is now evident, not only that herring select hard ground, but also that they prefer to deposit their spawn in the hollow somewhat basin-shaped gravel-coated areas, where presumably the water is

* 'On the Natural and Artificial Fertilisation of Herring Ova,' *Proceedings Royal Society*, London, 1884.

stiller than over the stone-covered ridges. This conclusion was arrived at after the various parts of the bank had been repeatedly sounded and dredged, and after some of the basin-shaped portions had been examined by a diver. While small groups of eggs were found coating the stones (Pl. IX. figs. 1 and 2), on various parts of the bank, it was only in gravel-coated basins that spawn was found in great abundance, where it covered many square yards with a layer nearly half an inch in thickness (Pl. IX. figs. 3 and 4). In addition to covering the gravel, the eggs were, however, often found arranged in low conical masses over the surface of the long stems of laminaria (Pl. IX. fig. 5).

An indication of the position, form, and depth of the Ballantrae Bank will be obtained by a reference to the chart (Pl. VI.), prepared by Sub.-Lieut. H. T. Hibbert of H.M.S 'Jackal.' This chart shows that the bank, which is of an irregular elongated form, is covered with from 7 to 13 fathoms of water, and that while within the bank the water is shallower, it soon increases to over twenty fathoms on the outer edge of the bank. Between the bank (*i.e.* the portion enclosed by the dotted red line) and the shore, the bottom consists chiefly of fine sand, while on the north, south, and east of the bank, the bottom is muddy, or covered with a mixture of mud and sand. The surface of the bank consists chiefly of polished stones, fine gravel, and coarse sand, the stones being especially abundant at the middle and lower portion of the bank (Stations IX., XI., XII., and XIII.), while the gravel and sand were especially abundant at the upper end, in a basin-shaped area extending between the stations, marked XVIII., XXIII., and XXIV. on the chart, XVIII. being near the centre of the basin, with 11 fathoms of water.

On the east coast, judging from the specimens of eggs brought up by the long line fishermen, the herring seem to select hard ground covered with a plentiful growth of sea-firs, especially with hydrallmannia (Pl. VII.), and antennularia (Pl. VIII.); but, as on the Ballantrae Bank, the greater portion of the spawn may be deposited on flat areas covered with coarse sand or gravel.

The temperature and saltness of the water seem to have little influence with the herring when selecting a spawning ground, for they spawn equally readily whether the temperature is at 40° Fahr. or 60° Fahr., and whether the specific gravity of the water is high or low—the Baltic herring depositing their spawn in almost fresh water. Further, the depth of the water within certain limits seems not to be of vital importance, for in the Schlei the herring spawn in half a fathom of water, while in the North Sea some of the sea-firs, with eggs attached, are said to have been taken in forty fathoms of water. But though the depth may neither influence the herring in selecting the spawning ground, nor when over thirty fathoms do more than slightly retard development, it may have a great influence over the young fry. The fry, as will be afterwards pointed out, begin to ascend as soon as they are hatched, in order apparently to reach the upper waters, in which their food is to be found; but it is possible that with their limited powers they may be exhausted by the attempt to rise from 50 to 100 fathoms, and ultimately falling to the bottom, succumb for want of nourishment.

It may be mentioned that any given spawning ground may be influenced by a great increase of the fish, and other forms which feed on the herring spawn, or by the impurity of the water covering it. On the Ballantrae Bank the spawn seemed to lie almost unmolested, while the water was remarkable for its purity.

In nearly all the inquiries made by Royal Commissions, fishermen and others indicated that they believed there was some relation between the disappearance of the herring from any given spawning ground and the

loss of herring nets during storms, or when over-fished. In this way the disappearance of herring from the once much-frequented spawning bank off Dunbar, and from the equally famous Guillam Bank in the Moray Firth, has been accounted for by many intimately acquainted with fishery questions. The reason given for the disappearance of the herring is that the nets loaded with putrefying fish, which are left on the spawning ground, cause the surviving herring to select more agreeable banks elsewhere.

It is further stated that the presence of the bones of herring previously destroyed are sufficient to drive away any shoals that may reach the bank during one or more spawning seasons, after the destruction of the herring occurred.

Having again and again brought up trammel nets when on the Ballantrae Bank loaded with fish in all stages of putrefaction—nets which when nearing the ship gave abundant evidence of their approach—I was led to consider what influence the loss of nets might have in causing herring to forsake their usual spawning beds. At first I was inclined to accept the theory that the presence of the nets, or the remains of dead fish, led to the desertion of the bank, but after further inquiry and consideration I believe that the lost nets (if they have any influence in destroying the fishing at any station), do not so much frighten away the herring as lead to the destruction of the greater portion of the spawn deposited on the bank. This will be best understood by an example. Let us suppose the spawning ground is limited, and that some hundreds of nets are lost either owing to a storm or because of their giving way through the excessive number of fish taken. Let us suppose further, that these nets are lost over, or are carried by the waves into the basin-shaped areas, where, as the observations made seem to show, the greater portion of the spawn is deposited, we can easily understand how the meshed fish, as they begin to putrefy, will taint the water in their vicinity, and gradually lead to the destruction of the developing embryos, which are so sensitive to impurities of all kinds.

This pollution would be continued and extended by portions of the nets continuing to fish throughout the whole season, so that not only might the eggs first deposited be destroyed, but fish which might have spawned at some other part of the bank would be taken, and their eggs though shed rendered useless, for although portions of the lost nets secured were thickly coated with eggs (Pl. IX. fig. 8), the eggs were never developing, they had probably never been fertilised. In this way the greater part of a shoal might be destroyed, and what is of even greater importance, nearly all the eggs deposited during the spawning period might also be destroyed, so that only a comparatively small brood would be hatched, the survivors of which, instead of returning when ready to spawn to their birth-place, might in answer to their strong gregarious instinct, cast their lot with the first large shoal they met in with.

IV.

THE SPAWNING OF THE HERRING.

At the beginning of the century it was known that herring spawned over ground 'neither rocky nor sandy,' but consisting 'of gravel more or 'less coarse;'* but how the spawn was deposited, whether at the bottom or near the surface, seems not to have been observed. Widegren,† in an essay 'On the Herring,' mentions that the whole process of spawning occupies not more than five or six hours, and that the males pour milt over the eggs after they have been deposited by the females.

* Prof. Walker, *Trans. of High. Soc.*, 1803.

† United States Com. Rep., part iii.

Ljungman,* who has studied the habits of the herring on the coast of Sweden, states that 'during the spawning season the herring are not 'afraid of the net even in broad daylight, but rush blindly towards it, 'seemingly with the intention of squeezing themselves into its meshes, 'and this in such a furious style that they frequently push down the net 'entirely.' Ljungman further adds, that 'during spawning the herrings 'are packed in a dense mass, are in constant and violent motion, move 'their tails rapidly, press and rub against each other or against the 'bottom, press against the nets, &c., all with the obvious intention to 'facilitate the emptying of the sexual organs;' and that during the escape of the milt the sea-water assumes a whitish colour, and many scales rise to the surface. He believed that the female fish generally go nearer the bottom than the male fish. Hensen† mentions that the roe is freely emitted by the female while hurrying to and fro over the spawning-place.

Mitchell, in his book on *The Herring*, mentions that once at Dunbar 'the fishermen found that a very large body of herrings remained fixed to 'the ground in the process of spawning.'

Many other accounts of the spawning process have been given, but only in one instance is there any evidence of the actual shedding of the milt having been observed. This exception is referred to in an essay (MS.) on The Herring, by Mr John Murray, Fishery Officer at Stonehaven, who states that a Lochfyne fisherman noticed that herring which he found spawning in a shallow pool were 'swimming edgeways together in con-'centric circles.'

In order to ascertain what really occurred during the deposit of the spawn, a number of observations were made during March and April last, when, at the request of the Board, I joined H.M.S. 'Jackal,' to inspect the herring fishing on the Ballantrae Bank. From these observations there was no evidence that the herring, when undisturbed, were packed in dense masses, or that they darted wildly about, nor yet that they rushed blindly towards the net, with the intention of squeezing themselves into its meshes; on the other hand, there was abundance of evidence to show that the females at least remained almost motionless while the eggs escaped. But when the herring were pursued by dogfish and other enemies, they darted about in great excitement, and this excitement was greatly increased when some of the spawning fish were meshed. Under these circumstances great alarm seemed to prevail, and the herring, evidently endeavouring to escape, rushed to and fro, often rubbing against each other, and in the excitement unconsciously shedding their spawn on the way. This reflex or unconscious shedding of the spawn especially occurred when full fish were taken in the trammel nets, but seldom had the eggs found adhering to the net been fertilised. In all probability, herring, like most other creatures during the breeding season, are less careful of their safety than under ordinary circumstances, and are hence less easily disturbed; but even at this time, as experiments showed, they are quite alive to the necessity of escaping from their enemies.

Apart, however, from the observations made during the spawning process, there is other evidence in support of the fact that the female herring at least are comparatively quiescent while the ova escape. If the eggs were shed while the fish were darting wildly about, they would be found scattered irregularly over the spawning ground occasionally in thick compact layers. Although many millions of eggs were obtained from the Ballantrae Bank, in no instance could they be said to form such lumps as former writers often refer to. Whether they were on sea-firs, sea-weeds

* United States Com. Rep., part vi.

† *Jahresbericht der Com. in Kiel*, iv.–vi.

(Pl. IX. fig. 5), stones (Pl. IX. figs. 1 and 2), or gravel (Pl. IX. fig. 3), they were always arranged in small, usually conical groups, which could only have been formed by the condensation of a continuous ribbon of eggs deposited while the female was at rest. The lumps of spawn sometimes found are probably formed out of the eggs which are thrown overboard by the fishermen when cleaning their boats, or by the rolling action of the waves during storms.

In several instances, when a large dredge came up full of spawn, I thought that I had at last come upon a part of the Ballantrae Bank, where the eggs lay 'to a very great depth,' but on examination it was always found that the spawn, instead of forming thick masses, was arranged in irregular heaps ranging from a quarter to half an inch in thickness,—the eggs nearest the gravel being often at a more advanced stage of development than those on the surface, but owing to the openness of the arrangement having a plentiful supply of water in contact with them (Pl. IX. figs. 3 and 4). In such cases the sizes of the individual masses were sometimes scarcely over an inch square, while at other times they were nearly 6 inches square. By laying the various portions side by side in a large tank, it was possible to obtain a very accurate notion of the arrangement of the eggs before they were disturbed by the dredge, and to feel satisfied that an almost regular layer of eggs often cover several square yards of the bottom.

In settling the question as to how the spawn is deposited, it is no longer necessary to trust to the inferences made either from the examination of the spawn dredged from the bottom, or from watching the somewhat uncertain movements of the herring on the spawning ground, for I found it possible to study the actual process of shedding the roe and the milt by placing ripe herring from Ballantrae in tanks at the Rothesay Aquarium. An account of the observations made is contained in the paper mentioned above.* In this paper the natural spawning process is described as follows:—

Having secured at Ballantrae a large number of live herring, we † selected the largest and ripest males and females, and placed them in a large wooden tank, into which a number of stones and a quantity of sea-weed had been previously introduced. After the fish had been about two hours in this tank the stones and sea-weed were examined, and although a few eggs were attached to them, it was quite evident that they had not been deposited in the same way as those found on the stones dredged on the previous day, but the presence of the eggs indicated that we had secured ripe females. We were not surprised that only a few isolated eggs were found on the stones, because the fish had been disturbed every few minutes by the water poured into the tank in order to keep the water sufficiently cool and abundantly aërated. Having arranged a tent-like covering over the tank, so as to inclose the fish in a dark chamber, we tried the effect of throwing instantaneous flashes of light on the surface of the water, but as far as could be observed this produced no impression whatever ; they neither sought the light nor avoided it, neither did they seem in any way startled, however suddenly it was directed across their path. This led us to believe that their natural movements would not be seriously interfered with when introduced into the tanks at the Rothesay Aquarium.

On reaching Rothesay the hatching boxes and live herring were at once transferred from the 'Jackal' to the tanks; a tank into which

* 'On the Natural and Artificial Fertilisation of Herring Ova,' *Proceedings Royal Society*, 1884.

† Lieutenant Prickett, R.N., took part in this investigation.

comparatively little light entered was selected for the ripest and most vigorous herring. In about half an hour after they were introduced we noticed a large full herring moving slowly about the bottom of the tank, and thinking it had suffered during the journey, I introduced a landing-net, in order to remove it, when, much to my surprise, it darted to the opposite end of the tank. I, however, without much difficulty, secured the herring, and having ascertained it was a perfectly ripe female, again set it free. In a few minutes I noticed her moving slowly quite close to the bottom of the tank, with four other fish making circles around her at some distance from the bottom. Appearing satisfied with some stones which she had been examining, she halted over them, and remained stationary for a few minutes about half an inch from their surface, the tail being in a straight line with the trunk and the pectoral fins near or resting on the bottom. While in this position, a thin beaded ribbon was seen escaping from the genital opening to fall in graceful curves on the surface of the stones so as to form a slightly conical mass, almost identical with a cluster of ova on one of the stones dredged at Ballantrae. As the little heap of eggs increased, some falling to the left side one moment, while others fell to the right the next, according to the currents in the water, the males continued circling round her at various distances, while the other females in the tank remained apart. The males remained from 8 to 10 inches above the bottom of the tank and formed circles ranging from 18 inches to 30 inches in diameter. Some of the males were swimming from right to left, others from left to right, and although there was no darting about, no struggling among themselves (there is nothing about the structure of the herring that suggests struggling), no great excitement, there was a peculiar jerking of the tail as they performed their revolutions. Soon the object of this peculiar movement was sufficiently evident. Three or four times during each revolution each fish expelled a small white ribbon of milt, which varied from half an inch to three-quarters of an inch in length, and was nearly a line in breadth across the centre, but pointed at both ends, and somewhat thinner than it was broad. The delicate ribbons slowly fell through the water, sometimes reaching the bottom almost undiminished in size, but in most instances they had almost completely dispersed before reaching the bottom. In this way the whole of the water about the female became of a very faint milky colour, and practically every drop of it was charged with sperms, as was afterwards ascertained. It will thus be seen that there is no attempt whatever on the part of the males to fertilise the eggs as they escape from the female. While the female is depositing eggs at the bottom the males concern themselves with fertilising the water in the neighbourhood, and it will be observed that the males are careful to guard against the influence of currents. By forming circles around the female, and shedding milt on the way, it matters not how the currents are running, they are sure to carry some of the milt towards the eggs—the milt, like the eggs, sinking, though, not adhering to the bottom.

When the female had deposited a certain number of eggs at any given spot, she moved forward in a somewhat jerky fashion without rising from the bottom, and as she changed her position the males changed theirs, so that the female was always surrounded by a fine rain of short sperm ribbons. A specimen of hydrallmannia (Pl. VII.) sent from Eyemouth, seems to indicate that the female moves about amongst sea-firs and sea-weeds in exactly the same way as she does amongst stones. On each stem of the colony there is a cluster of ova about the size of a small grape, and all the clusters had reached, on arrival, the same stage of development as if they had been deposited about the same time and by the same fish.

It is easily understanding how such clusters may be formed if the female is almost in contact with the stems, and there is nothing easier than to form such clusters artificially; the first eggs adhere to the stem, then the others adhere to the eggs already deposited, but being heavy, some of them roll over to the under aspect, so as to form the lower half of the sphere, and the result is that, partly owing to the stems moving slightly, there are usually as many eggs on their under as on their upper surface. It would, however, be extremely difficult to understand how such clusters or how conical masses could be formed on stones if the eggs fell several fathoms before reaching the bottom.

This method of depositing and fertilising the eggs accounts, I think, for all the eggs, or, at least, for a very large percentage of those found attached to sea-firs, sea-weeds, and stones, containing developing embryos.

When a female was depositing her eggs she was very easily disturbed; whenever anything was introduced into the tank she at once darted off. When strong currents were made she at first seemed to apply herself nearer to the bottom to make sure, as it were, that the spawn would get fixed before it could be carried away; but when the currents were further intensified, she at once changed her position, and arrested the escape of the spawn.

A spawning female was held immediately under the surface of the water so as to cause the spawn to escape. When this was done, it escaped in a long ribbon consisting of a single row of eggs. So firmly do the eggs adhere to one another, that in perfectly still water the ribbon was sometimes over a foot in length before it broke. When it had only about 2 feet of water to travel through, it fell in wide loops to the bottom, but when it had over 3 feet to fall, the chain broke up into numerous segments which formed an irregular pattern on the bottom. From experiments made it seems the further the eggs have to fall, and the longer they are in contact with the water before they reach the bottom, they are more widely dispersed, and have all the less adhesive power. When the eggs are expressed in water moving rapidly in various directions, the chains soon break into short segments, and the individual eggs and the small groups are often carried a considerable distance before they reach the bottom. It will be evident that if the eggs are shed in strong currents some fathoms from the bottom, the chances of their being fertilised will be considerably diminished. When the sea is rough the fishermen seldom expect a good 'take;' they believe, in fact, that during storms the herring leave the spawning ground; and if the eggs are always deposited as I have described, we can easily understand that this might well be the case. Sometimes, about the middle or near the end of the spawning period, the whole school disappears in a single night. This generally happens during or immediately after a storm, or some other disturbing cause. It may be accounted for by supposing that the herring being ready to spawn, or having already begun to deposit their eggs, finding the conditions on their usual spawning grounds unfavourable, deserted them for banks at some other part of the coast or at some distance seawards.

A number of flat stones and pieces of sea-weed were obtained, and a spawning female held over them at different distances in still water, in water with gentle currents, and in water with strong currents. In this way groups of eggs were obtained which mimicked in a very striking manner all the arrangements of the eggs on the stones and sea-weeds dredged on the Ballantrae Bank. When gently pressed a beaded ribbon, consisting of a single row of eggs, always escaped. When there were no currents it formed conical heaps; when gentle currents the ribbon fell in irregular loops, the elements of which arranged themselves so as to form a flattened cone; but when strong currents acted on it, the ribbon was

broken into fragments, and only a few eggs succeeded in fixing themselves in the vicinity of the stones and sea-weed.

When the currents were strong, the males were seen not only to swim nearer the bottom, but to expel longer ribbons of milt, which reached the bottom before getting dispersed, and remained visible sometimes for ten minutes. On gently expressing a male under the water, it was never possible to expel so fine or so short portions of milt as escaped naturally, but it was extremely easy expelling a ribbon from 18 inches to 3 feet in length, measuring two lines across, and one line in thickness. Such ribbons fell to the bottom, and remained almost unchanged for nearly two hours, they then assumed a segmented appearance, and in about 3½ hours had all but disappeared.

Eggs were allowed to escape into a vessel containing fine sand, and into another containing mud. The eggs after being fertilised underwent the early stages of development, but, either owing to their moving freely about with the sand particles, or owing to their getting coated over with the sand and mud, their further development was arrested.

V.

ARTIFICIAL FERTILISATION AND HATCHING OF HERRING OVA.

In referring to the artificial fertilisation of herring ova in the paper presented to the Royal Society, I mentioned that the best results were obtained when the natural process of spawning was as far as possible followed. The plan adopted is described as follows :—

'An ordinary wooden tub was obtained and filled with sea-water. 'Into this a small quantity of milt was expressed, the male being held 'completely under water while the milt escaped. A glass plate was 'then held about 4 inches beneath the surface of the water, and the 'female herring about 1 inch beneath the surface, and then under gentle 'pressure the eggs readily escaped in the characteristic narrow beaded 'ribbon, and by moving the fish over the surface of the glass either a 'close or an open network could be formed. At first, where one loop 'crossed another, the eggs were two or more layers thick, but either 'owing to the weight of the eggs or the gentle currents set up in the 'water, before a few minutes had elapsed the eggs formed a single and 'almost continuous layer, the network arrangement having disappeared. 'The plate was then allowed to rest for two or three minutes at the 'bottom of the tub and a few short ribbons of milt were again introduced. 'After moving the plate once or twice across the top of the tub in order 'to wash off any scales that were adhering, it was placed either in a 'hatching or in a carrying box.' Fig. 6, Pl. IX. shows a continuous ribbon which was expressed from a living herring, and fig. 7, of the same plate shows how the eggs of a similar ribbon arranged themselves to form a single and almost continuous layer.

Many thousands of eggs treated in this way on the 8th March hatched out on the 26th, 29th, and 30th March—eighteen, twenty-one, and twenty-two days after fertilisation, the temperature varying from 41° to 44° Fahr. The method of escape was carefully studied. It was found that when the eggs had been provided with a plentiful supply of pure water, the embryos were extremely active—revolving within the capsule or wriggling from side to side until the capsule ruptured and allowed the larval herring to escape head foremost. When, on the other hand, the supply of pure water had been limited, the capsule often gave way before the time for hatching had arrived, and the result invariably was that the long

slender body escaped, while the head remained within the egg capsule, and, notwithstanding great efforts made to escape, the embryo usually perished. It was observed that hatching was greatly expedited when the temperature of the water was slightly raised, and that hatching took place in a perfectly normal way even after the eggs were detached from their anchorage.

As soon as the fry escaped they began to ascend by a wriggling motion towards the surface of the water, rising at first only a few inches at a time, to turn and slowly sink head downwards towards the bottom. During the first day they seldom succeeded in rising more than two or three feet from the bottom, and this they only succeeded in accomplishing after many attempts, but on the second day they readily, almost without a single rest, rose three feet at a time, and on the fourth day they succeeded in swimming freely about the surface of the water. The instinctive desire to rise to the surface as soon as they escape from the egg capsule is evidently intended to bring them to the vicinity of the food on which, after the fourth or fifth day, they depend for their nourishment.

DESCRIPTION OF THE PLATES.

Plate IV.

Fig. 1.—Sketch of a well-developed full spring Herring, taken off Wick, March 1884.

Fig. 2.—Sketch of a full male spring Herring, taken off Anstruther, with the dorsal fin placed further back than usual.

Fig. 3.—Sketch of a full male spring Herring, taken off Anstruther, the same absolute size as fig. 2, but with the dorsal fin considerably further forward than in fig. 2. *a. b.* indicates the position the dorsal and pelvic fins occupy in fig. 2, and *c. d.* the position of the same fins in fig. 3.

Plate V.

Fig. 1.—Shows a full Herring, sent from Girvan on the 29th March 1884, which measured 13 inches in length, and weighed 12 ounces.

Fig. 2.—Shows a spent Herring of the same absolute length, sent from Girvan at the same time. In fig. 2 the dorsal fin is considerably further forward than in fig. 1, and the pelvic fin is somewhat further back. *c. d.* indicates the position of the dorsal and pelvic fins of fig. 2.

Plate VI.

Shows the part of the Ballantrae Bank on which spawn is chiefly deposited; the spawn was found in greatest abundance between the Stations XXIII., XXIV., and XVIII.

Plate VII.

Shows a colony of *Hydrallmannia falcata*, with four groups of Herring eggs attached to its stems.

Plate VIII.

Shows a specimen of *Antennularia antennina*, with three groups of Herring eggs attached.

Plate IX.

Figs. 1 & 2.—Shows stones with Herring eggs attached, dredged from the Ballantrae Bank (Station XII. Pl. VI.). Eggs on fig. 1 hatched on the 18th March.

Fig. 3.—Shows a layer of Herring Eggs, half an inch in thickness, attached to gravel from the Ballantrae Bank. It has not been possible to show distinctly the open arrangement of the eggs in conical heaps.

Fig. 4.—Shows the under surface of a similar layer of Eggs, with the pieces of gravel to which they adhere.

Fig. 5.—Shows Eggs arranged as in fig. 3 on a piece of Laminaria.

Fig. 6.—Shows a continuous ribbon of Eggs, expressed from a living Herring on to a piece of glass.

Fig. 7.—Shows the form assumed by Eggs some time after they escape. Herring fry developed from artificially fertilised eggs fixed to glass plates, as shown in this figure, were exhibited at the Royal Society, London, on Thursday, 27th March 1884.

Fig. 8.—Shows a portion of Trammel Net dredged from the Ballantrae Bank, which contained some living herring, and a large number of dead herring at various stages of decomposition. The group of eggs figured was near a female herring, which had spawned after it was taken, but the eggs had not been fertilised. Small groups of eggs, which had been carried away by the currents, were attached to the net for some distance at each side of the large group shown.

APPENDIX F.—No. V.

LIST OF EDIBLE BRITISH FISHES, with their English, Latin, French, Italian, and German Synonyms.

By NELLIE MACLAGAN.

English.	Latin.	French.	Italian.	German.
Anchovy	Engraulis encrasicolus	Anchois	Acciuga	Sardelle
Angler	Lophius piscatorius	Baudroie pècheresse	Boldrò	Seeteufel
Atherine	Atherina presbyter	Petit Prètre	Latterino, Sardaro	...
Barbel	Barbus vulgaris	Barbeau	Barbio, Barbo	Barbe
Bass	Labrax lupus	Bar	Ragno (Tuscany), Spigola (Rome)	Sandart, Zander
Boarfish	Capros aper	...	Pesce porco	...
Bogue = Ox-eye	Box vulgaris	...	Boga, Boba, Vopa	...
Bream, Fresh Water	Abramis brama	Brême	Branzino (Venice)	Brassen, Brachsen
Bream, Rays	Brama Raii	...	Occhiada, Castagnola	Castainale
Bream, Sea	Pagellus centrodontus	Pagelle	Pagello rosso, Besugo (Genoa)	Blei
Brill	Rhombus laevis	Barbue	Soazo, Sfazo, Rombo	...
Carp	Cyprinus carpio	Carpe	Reina	Karpfe
Char, Alpine	Salmo alpinus	Saumon Alpin	...	...
Char, American	Salmo fontinalis	Saumon des fontaines	...	...
Char, Willughby's	Salmo Willughii	...	...	...
Chub	Leuciscus cephalus	Chabot, Meunier	Squal, Cavedano	Kaulbörs
Coalfish	Gadus virens	Colin, Morue noire	Merlango nero	Köhler, Kohlfisch
Coalfish, young = Saithe		Mollet	...	Grundoroch
Cod	Gadus morhua	Cabilland, Morue	Merluzzo	Kabeljau
Comber	Serranus cabrilla	Serran	Boccaccia, Perchia	...
Conger-Eel	Conger vulgaris	Congre, Anguille de mer	Grogno	Meeraal
Coregonus	Coregonus oxyrhynchus	Coregone oxyrhynque	...	Schnepel
Crucian Carp	Carassius vulgaris	Carassin commun	...	Karausche
Dab	Hippoglossoides limanoides	Limande	...	Butte
Dab, Smear	Pleuronectes microcephalus	Plie microcéphale	...	...
Dab, Pole	Pleuronectes cynoglossus	Plie cynoglosse	...	...
Dace	Leuciscus vulgaris	Vaudoise, Dard	Lasca	Weisfisch, Lauben
Dentex	Dentex vulgaris	...	Dentice	Zahnbrasse

English.	Latin.	French.	Italian.	German.
Eel	Anguilla vulgaris	Anguille	Anguilla	Aal
Eelpout	Gadus lota	Lotte	...	Quappe
Flounder	Platessa flesus	Flét, Carrelet	Passera	Thorbutte, Flunder
Forkbeard, Greater	Phycis blennoides	...	Figo	...
Garfish	Belone vulgaris	Orphie	Aguglia	Hornhecht
Gilthead	Pagrus auratus	Chrysophris, Dorade	Orata	Goldbrassen, Goldfohre, Goldforelle
Grayling	Thymallus vulgaris	Omble, Ombre	Temolo	Gräsling
Gudgeon	Gobio fluviatilis	Goujon	Ghiozzo	Gründling
Gwinead	Coregonus clupeoides	Corégone clupéode	...	Ranken
Gurnard = Gurnet Butterfly	Trigla hirundo	Trigle	Cappone, Auzoleto	Seeschwalbe
Gurnard, Gray	Trigla gurnardus	Grondin	Pesce capone	Knurrhahn
Gurnard, Lanthorn	Trigla obscura	...	Barilotto, Gavotta	...
Gurnard, Red	Trigla cuculus	...	Pesce capone	...
Gurnard, Streaked	Trigla lineata	...	Ubbriagon, Musoduro	...
Haddock	Gadus æglefinus	Aiglefin, Aigrefin	...	Schellfisch
Hake	Merluccius vulgaris	Merluche	Nasello	Rothauge
Holibut	Hippoglossus vulgaris	Flétan	...	Heilbutte, Hellbutte
Herring	Clupea harengus	Hareng	Aringa	Häring
John Dory	Zeus faber	Poisson St Pierre	Pesce San Pietro	S. Petersfisch, Sonnenfisch
Lamprey, Freshwater	Petromyzon fluviatilis	Lamproie fluviatile	Lampreda	Pricke
Lamprey, Sea	Petromyzon marinus	Lamproie marine	Lampreda	Lamprete
Ling	Lota molva	...	...	Leng, Langling, Langfisch
Loach or Groundling	Nemacheilus barbatus	Loche, Dormille	Forasassi	Schmerle, Schmerling
Loach, spined	Cobitis taenia	Loche	Pessucola	Steinpitzger
Lumpfish = Lumpsucker.	Cyclopterus lumpus	...	...	Lump, Seehase
Mackerel	Scomber scomber	Macquereau	Sgombro	Makrele
Mackerel, Horse = Scad	Caranx trachurus	Roi des harengs	Suro	Stachelmakrete
Mackerel, Spanish	Scomber colias	Macquereau	Lauzarda, Cavallo	...
Mullet, Gray	Mugil capito	Mulet	Muggine	Riesenbarbe

APPENDIX F.—No. V.—*continued.*

English.	Latin.	French.	Italian.	German.
Mullet, Red	Mullus surmuletus	Rouget	Triglia	Rothbart, Meerbarbe
Old Wife	Cantharus lineatus	...	Cantera, Tenuda	...
Opah	Lampris luna	...	...	...
Perch	Perca fluviatilis	Perche	Pesce persico	Barsch, Börs
Perch, Dusky	Serranus gigas	Serran géant	Cernia	...
Pike	Esox lucius	Brochet	Luccio	Hecht
Pilchard	Clupea pilchardus	...	Sardella	Pilchard
Plaice	Platessa vulgaris	Plie	Passera	Plattfisch, Goldbutte
Pollack	Gadus pollachius	Gade pollach	...	...
Pollan	Coregonus pollan	...	...	...
Roach	Leuciscus rutilis	Rouget barbat	Lasca	Roche
Rockling, Five-bearded	Motella mustella	Motelle tigrée	...	...
Rockling, Three-bearded	Motella vulgaris	Motelle vulgaire	Mustella	Seequappe
Ruff = Pope	Acerina vulgaris	...	...	Goldbörs
Salmon	Salmo salar	Saumon	Sermone, Salmone	Salm, Lachs
Salmon, Severn	Salmo cambricus	...	...	...
Salmon Trout	Salmo trutta	Truite saumonée	Trota	Lachsforelle
Sand-eel	Ammodytes tobianus	Lançon	...	Sandaal
Sand-launce	Ammodytes lancea	...	...	...
Sardine	Clupea sardina	Sardine	Sardina	Sardine
Sciaena	Sciaena aquila	Scième	Bocca d'oro	Adlersfisch
Shad = Allis	Clupea alosa	Alose	Cheppia laccia	Alose, Maifisch
Shad = Twaite	Clupea finta	...	...	.
Skate	Raia batis, R. maculatus	Flotte	Razza	Meerroche, Mairoche
Sole	Solea vulgaris	Sole	Sogliola	Meersohle
Sole, Lemon	Solea aurantiaca	...	...	...
Sole, Variegated	Solea variegata	...	Palaja	...
Sparling = Smelt	Osmerus eperlanus	Epérlan	...	Stint, Seestint
Sprat	Clupea sprattus	Esprot	Papalino	Sprotte
Stone-basse	Polyprion cerneum	...	Cernia di funnale	...
Sturgeon	Acipenser sturio	Esturgeon	Storione	Stör
Swordfish	Xiphias gladius	Espadon	Pesce spada	Schwertfisch
Tench	Tinca vulgaris	Tenche	Tincà	Schlei

English.	Latin.	French.	Italian.	German.
Thornback	Raia clavata	Raie bouclée	Razza chiodata	Dornroche, Stachelroche
Torsk	Brosmius vulgaris	Brosme vulgaire	...	Dorsch
Trout	Salmo fario	Truite	Trutta, Trota	Forelle
Trout, Loch Leven	Salmo levenensis	...	...	...
Tunny	Thynnus vulgaris	Thon	Tonno	Thunfisch
Turbot	Rhombus maximus	Turbot	Rombo	Steinbutte
Vendace	Coregonus vandesius	...	...	...
Weaver = Wyvern	Trachinus draco, Trachinus vipera	Vive	Tacchino, Trasma, Autraciva	Petermännchen n. Seedrache
Whiting	Gadus merlangus	Mérlan	Molo	Weisling
Whiting Pout	Gadus luscus	Tacaud	Molo	Breiter Schellfisch
Wolf-fish	Anarrichas lupus	Loup de mer	...	Seewolf
Wrasse	Labrus maculatus	Labre, Veielle	Tordo	Meerschlie

LIST OF EDIBLE BRITISH MOLLUSCS AND SHELL FISH.

Clam	Hippopus maculatus	...	...	Hufmuschel
Cockle	Cardium edule	Buccarde	Cappa	Strahlmuschel
Cuttlefish	Sepia officinalis	Séiche	Seppia	Tintenfisch
Limpet	Patella vulgaris	Patelle	Patella	Napfschnecke
Oyster	Ostrea edule	Huître	Ostrica	Auster
Periwinkle	Littorina littorea	Bignoreau, Vignot	...	Herzmuschel
Scallop	Pecten maximus	Pétoncle	Pettine, Cappa santa	Jakobsmuschel, Kammmuschel
Whelk	Buccinum undatum	Buccin	Buccino	Trompeten Schnecke
Crab	Cancer pagurus	Tourteau	Ermita	Taschenkrebs
Crayfish	Astacus torrentium	Ecrevisse	Gambero	Flusskrebs
Lobster	Homarus vulgaris	Homard	Supiccante	Hummer
Lobster, Norway	Nephrops Norvegicus	...	Scampo (Venice)	...
Lobster, Spiney	Palinurus vulgaris	Langouste	Arrignsta	Languste
Prawn	Palæmon serratus	Chevrette	Gamberetto	Garnele, Seegarnele
Shrimp	Crangon vulgaris	Crévette	Gamberetto	Garnate

The author is indebted to Sir James R. Gibson-Maitland, Bart., Dr Day, and to Professors E. Van Beneden, Giglioli, and Haeckel for valuable assistance in preparing the above list.

APPENDIX F.—No. VI.

Note on a new Blenny (*Lumpenus lampretæformis*). Plate X

By Francis Day, F.Z.S.

Blennius capite lævi, &c., Mohr, Isl. Nat. p. 84, t. iv. (1786).
„ *lampretæformis*, Walb. Artedi. Gen. Pisc., p. 184, pl. iii., f. 6 (from Mohr), (1792).
Centronotus islandicus, Bloch, Schn. Syst. Ich., p. 167 (1801).
Blennius lumpenus, pt. Faber, Fische. Isl., p. 79 (1829).
Centronotus lumpenus, Nilss. Prod. Ich. Scand., p. 104 (1832),
Clinus nebulosus, Fries, Kgl. Vet. Ak. Hand., 1837, p. 49 (1837).
„ *mohrii*, Kr. Nat. Tids., i. R., i. B., 1837, p. 32 (1837).
Blennius gracilis, Stuwitz, Nyt. Mag. f. Nat., i. B., p. 406 (1838).
Lumpenus (*Clinus*) *gracilis*, Reinh. Kgl. D. Vid. Selsh. Nat. Math. Aph, 7 Del., p. 194 (1838).
„ *nebulosus*, Nilss. Skand. Fauna, u. Del. p. 195 (1855).
Stichæus islandicus, Gunther, Catal. Fish. Brit. Mus., iii. p. 281 (1861).
Centroblennius nebulosus, Gill, Proc. Acad. Nat. Sci. Phil., 1861, Aphen., p. 45 (1861).
Lumpenus gracilis, Kr. Nat. Tids., 3 R., 1 B., p. 282, Kbhvn. 1861–63 (1862).
„ *lampetræformis*, Collett, Norges. Fishe. Till. til. Fork. Vid. Selsk. Chra., 1874, p. 71 (1874), and Norw. North Atl. Esh., 1876–78 (1880). B. vi., D. 72, P. 14, V. 5, A. 52, C. 13, Cœc. pyl. 2.

Professor M'Intosh obtained this example, which is 10·7 inches in length, from a trawler which captured it in 40 fathoms of water 15 miles off St Abb's Head. It was first figured and described by Mohr in 1786, and had the specific term, *lampretæformis*, first bestowed on it by Walbaum in 1792. Schneider, however, in his edition of Bloch's *Ichthyologia*, alters this specific term to *islandicus*, and several other synonyms have been subsequently added. Gunther refers to '*Blennius* '*islandicus*, Walb. Art. Renov., iii. t. 3, f. 6,' which does not exist in my copy.

The specimen does not differ from the recorded descriptions, except in having one of the rays on either side of the caudal fin elongated, which I take to be a sexual character, as the specimen is a male, with the organs of generation well developed.

This fish, as observed by Collett, occurs on the coast of Greenland, Iceland, Spitzbergen, and the shores of north-western Europe as far south as the Cattegat; while to the north it extends at least to 80°. This specimen appears to be the first recorded from the shores of the British Isles.

APPENDIX F.—No. VII.

NOTE on some of the SPECIMENS forwarded by the OFFICERS of the BOARD. By J. COSSAR EWART, M.D.

1. *Torpedo nobiliana*, Plate XI.

This Torpedo was taken in a trawl in 40 fathoms water off Lybster, in January last, and forwarded by Mr Low. Torpedoes have probably been caught by fishermen in Scottish waters before, but none as far as I am aware have been preserved. The specimen sent to the Board measured 28 inches in length and 19½ inches across the pectoral fins, and was 13 pounds in weight. Being a rare form, it was presented to the Edinburgh Science and Art Museum. None of the existing drawings being satisfactory, a sketch (Plate XI.) has been made, which, in addition to showing the general form, the characteristic smooth oval spiracles, and the large first dorsal fin, indicates the position of the electric organs and of the system of sensory canals at each side of the middle line. The colour of the upper surface of *Torpedo nobiliana* varies from a reddish grey to nearly black, and there may even be large irregular spots scattered over it, while the under surface is always nearly white. In the Lybster specimen the upper surface was of a uniform dark chocolate colour.

Torpedo nobiliana has been described as—

(1) *Torpedo Walshii*, Thompson.
(2) *Torpedo hebetans*, Lowe, Günther.
(3) *Torpedo emarginata*, M'Coy.
(4) *Torpedo nigra*, Guichen.

It differs from *Torpedo marmorata* (which is also said to occur in British waters), in having the spiracles smooth, and the first dorsal fin considerably larger than the second—in *T. marmorata* of the Mediterranean the spiracles are fringed, and the first dorsal is only slightly larger than the second dorsal fin.

T. nobiliana is found in the Mediterranean and in the Atlantic as far south as Madeira. Specimens 3 feet in length have been taken off the coast of Cornwall.

2. *Serranus cabrilla*, Plate XII.

Serranus cabrilla (Comber) and occasionally *Serranus gigas* (Dusky Perch) are found along the south coast of England, but there is no record of either having extended into the North Sea. In Day's *British Fishes* it is mentioned that *S. cabrilla* 'does not appear to extend to the Straits 'of Dover on the east, nor so high as the Bristol Channel on the west;' and it is added that, 'it has not been recorded from Ireland.' It, however, is found in the Mediterranean, 'as far south as the Cape of Good Hope, and the Island of St Paul in the Southern Indian Ocean.

The specimen figured was taken recently 22 miles N.E. of Flugo Lighthouse (Shetland) in 80 fathoms water, and forwarded by Mr Macdonald, Fishery officer.

Serranus cabrilla has been described under the following names—

Χαvη, Salviani.
Perca, Rondel, Gesner, Brunnich, Jonston, Ray.
Perca channus, Couch.
Perca cabrilla, Linnœus, Gmel., Jenyns.
Holocentrus virescens, Block, Lacép.
„ *marinus*, Lacép.
Lutjanus serranus, Lacép.
Serranus marinus and *flavus*, Risso.
„ *novemcinctus*, Kner.
Comber, Couch.

If the figure given is compared with the one in Day's *British Fishes*, taken from a specimen 10 inches long obtained at Mevagissey, it will be observed that it differs in several points. The Shetland specimen has the back more arched, the eye relatively larger, three spines instead of one on the operculum, and five large spines instead of numerous small ones on the preoperculum. Further, it has four spines above the eye and a small spine above the nasal chamber, and the scales on the operculum are relatively smaller than in Day's figure.

3. *Rhombus maximus*, Plate XIII.

This specimen, which was forwarded from Anstruther in May, differs considerably from the normal Turbot. By a reference to the Plate, it will be observed (1) that instead of having both eyes on one side, the right eye is situated on the right side near the top of the head, while the left eye (indicated by dotted lines) occupies the usual position on the left side of the head; (2) that there is a rounded frontal process projecting forwards in the middle line above the head; and (3) that the anterior portion of the lateral line forms three irregular curves instead of one single curve. The specimen further differs from an ordinary turbot in having both sides of a uniform dark colour, and in having spines scattered irregularly over the right as well as the left side. It measures 22 inches in length, and 18 inches from the margin of the dorsal to the margin of the ventral fin. A turbot with an eye on each side of the head is referred to by Professor M'Intosh in his account of the fishes of North Uist. A further account of this specimen will be given by Dr Traquair, F.R.S., in the next Report.

4. *Lampris luna.*

A fine specimen of *Lampris luna* (opah), measuring 4 feet in length, was taken in 75 fathoms water 25 miles N.W. of Fluga Lighthouse (Shetland), in May, and forwarded from Lerwick by Mr Millikin. It is expected that Professor Turner, F.R.S., will give an account of some points in the anatomy of this fish in the next Annual Report.

Other objects of interest received by the Board are—(1) specimens of the acorn shell (Coronula) taken from the "Tay whale" (*Megaptera longimana*) by Mr Murray, fishery officer at Stonehaven; (2) a specimen of the lesser forkbeard (*Raniceps trifurcus*) taken in the Firth of Forth; (3) a specimen of the Greenland shark (*Laemargus borealis*), forwarded by Mr Doull from Eyemouth; and (4) a fine specimen of the Sapphirine Gurnard (*Trigla hirundo*), sent from Macduff. *Raniceps*, *Trigla*, and several other fish, have been presented to the Science and Art Museum.

DESCRIPTION OF THE PLATES.

Plate XI.

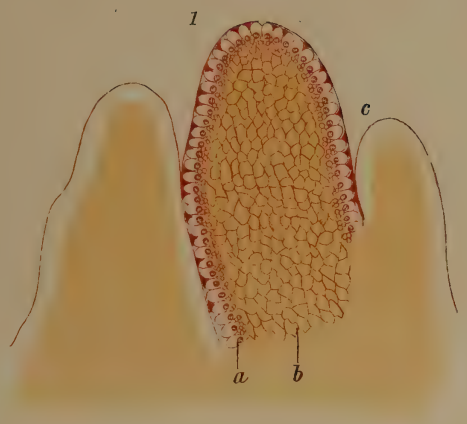
Sketch of *Torpedo nobiliana* taken off Lybster, in January 1884, showing the electrical organs, sensory canals, and spiracles.

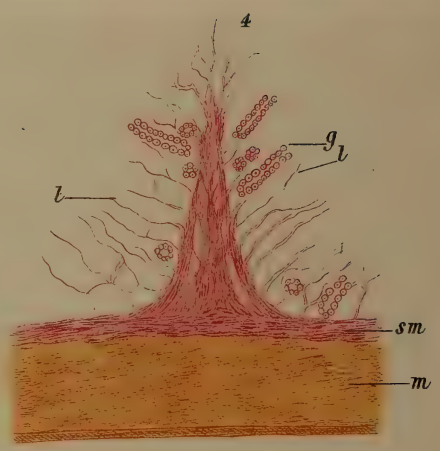
Plate XII.

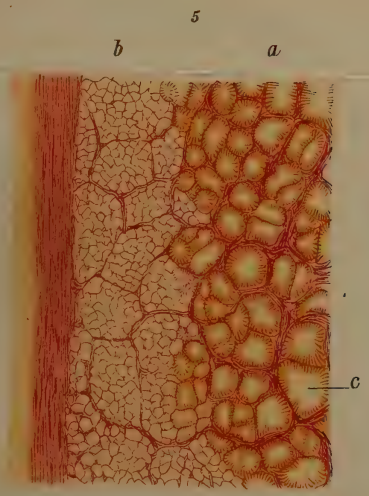
Sketch of *Serranus cabrilla* (nat. size), taken off Shetland in 80 fathoms water.

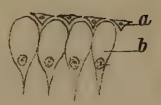
Plate XIII.

Sketch of a Turbot sent from Anstruther, May 1884, showing—(1) that the right eye is placed on the right side, while the left one, as the dotted lines indicate, occupies the usual position on the left side; (2) a process projecting forwards above the head; and (3) the irregularly curved lateral line.









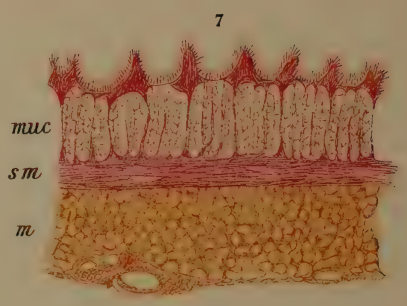


PLATE I.

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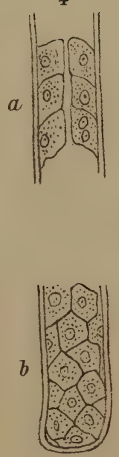

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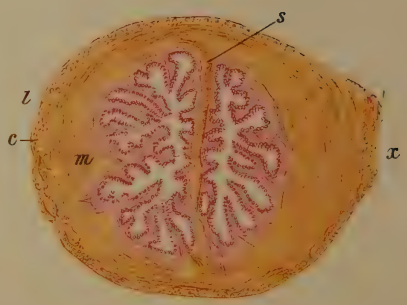

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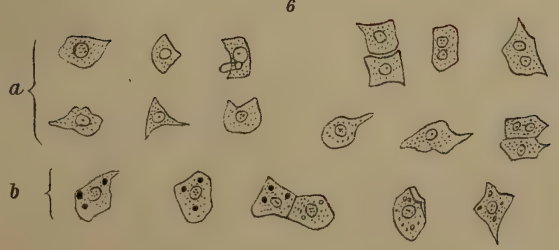

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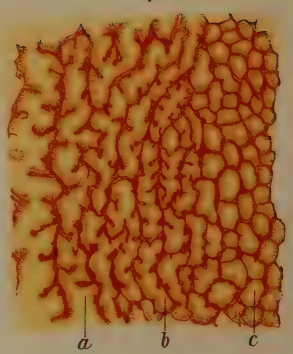
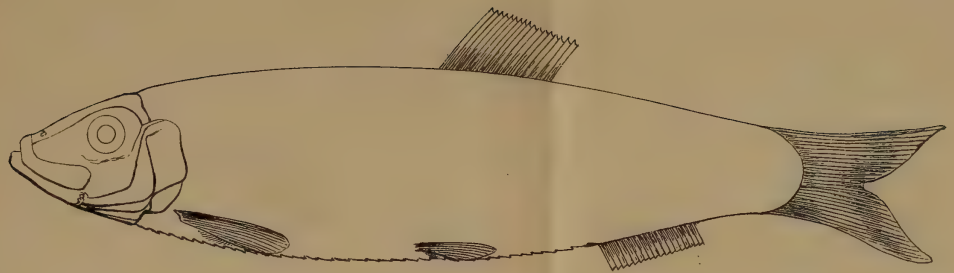


PLATE II.



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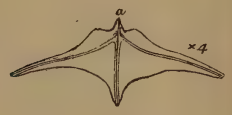

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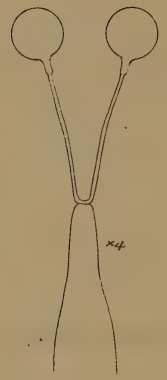

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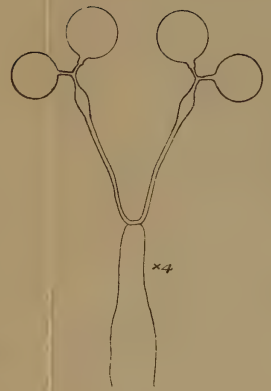

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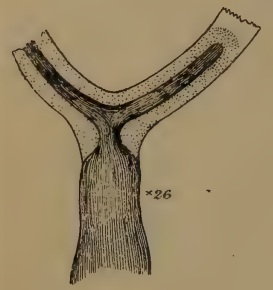

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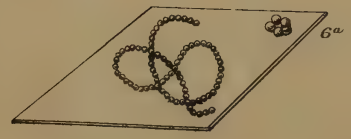

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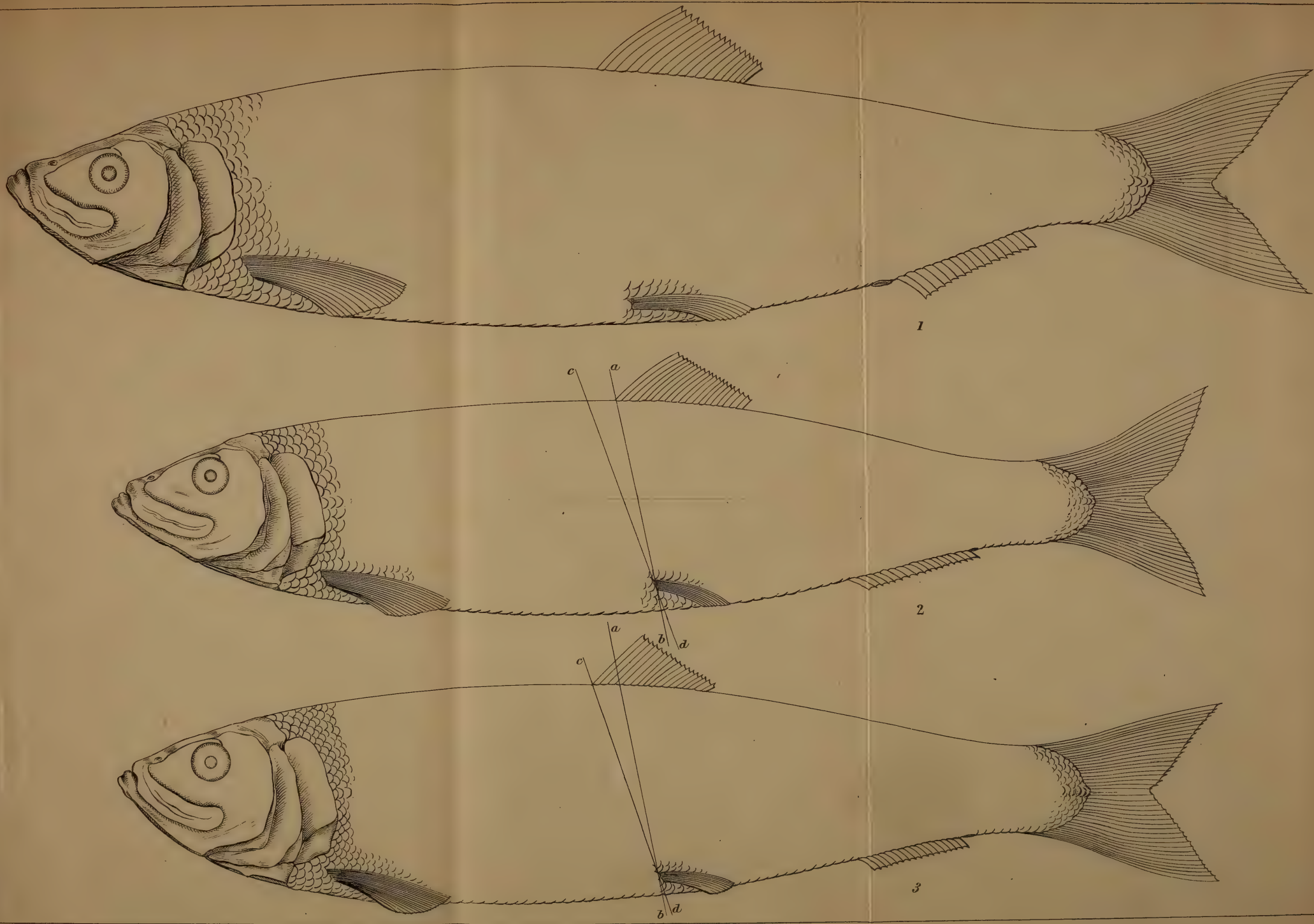
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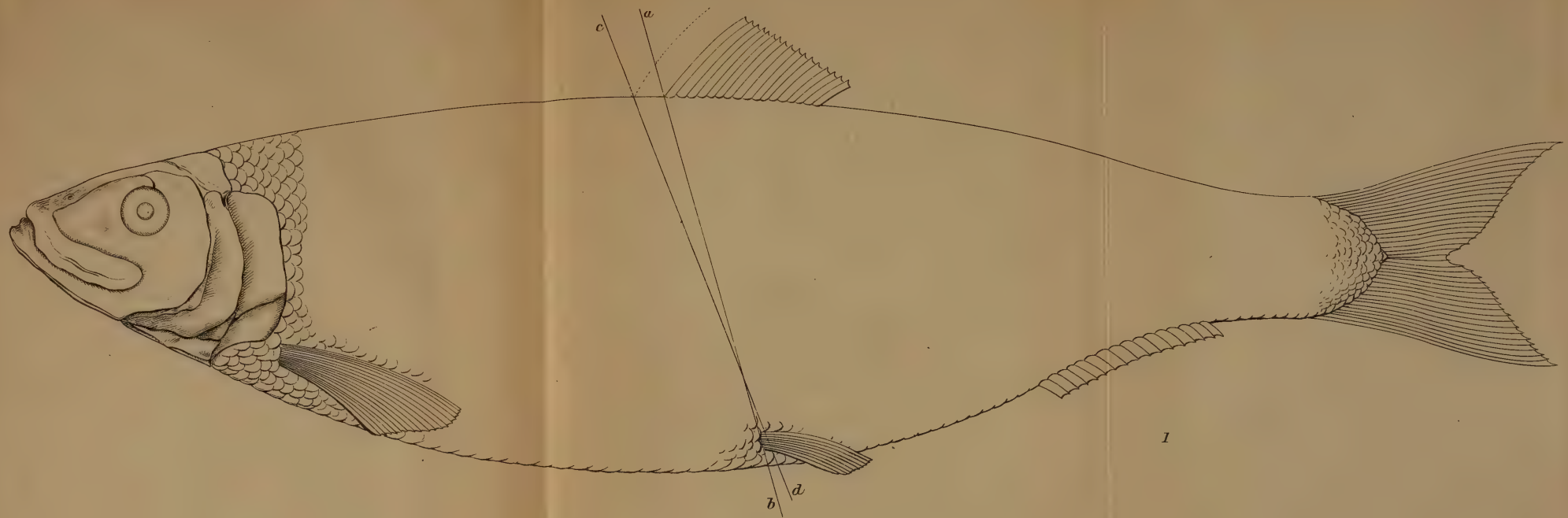

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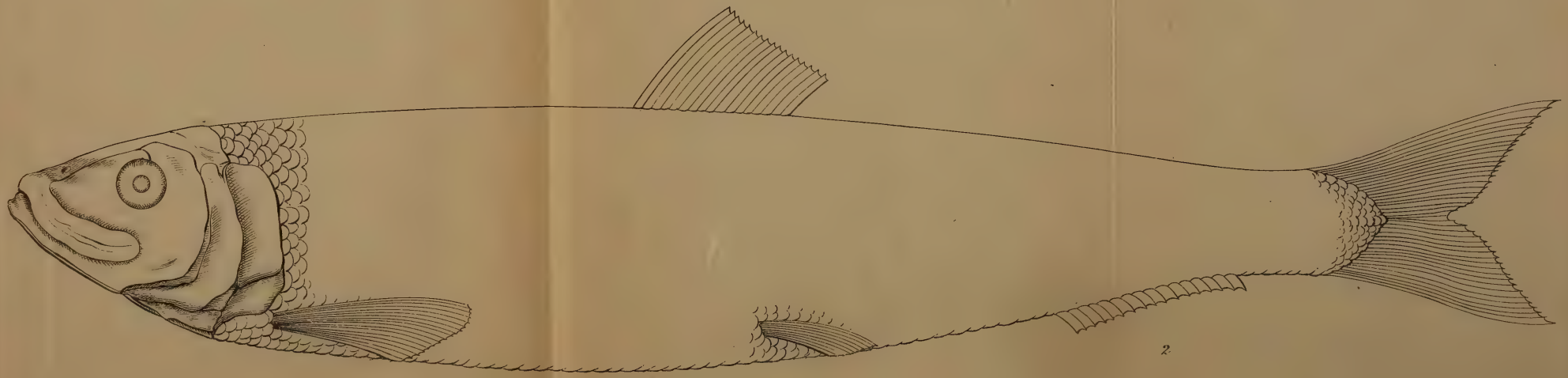

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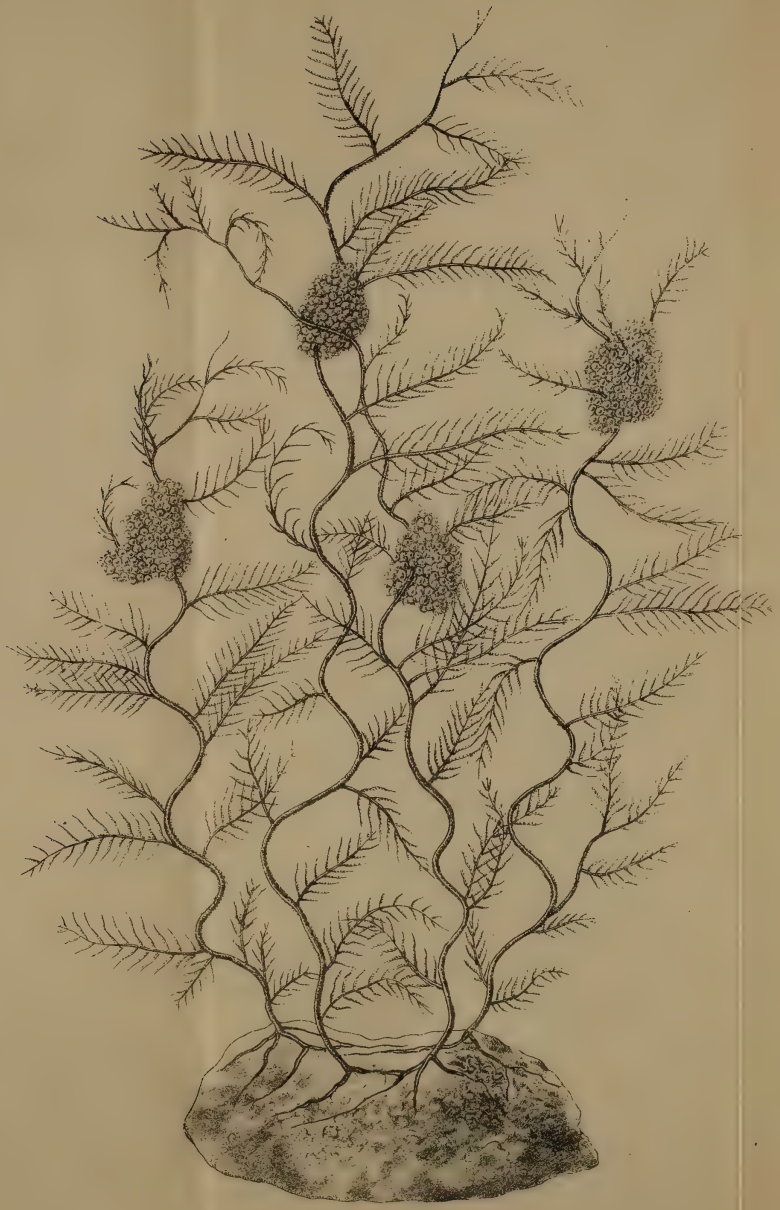
BALLANTRAE SPAWNING BANK

Soundings in fathoms (in black)
Nos of Stations (in red)



Hydrallmannia falcata

Antennularia antennina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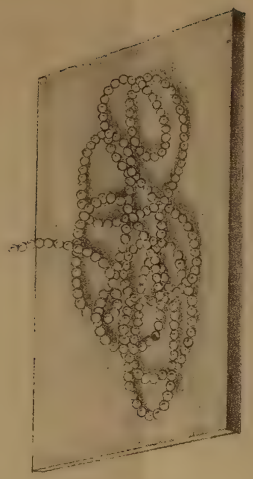
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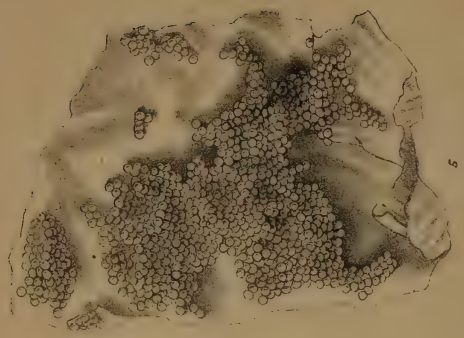
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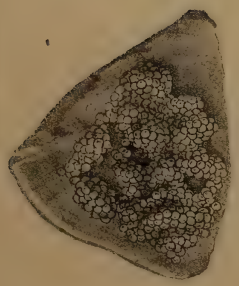
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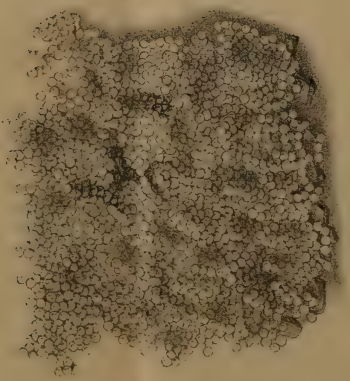
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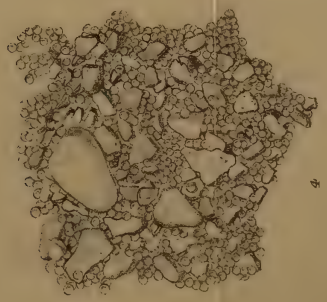
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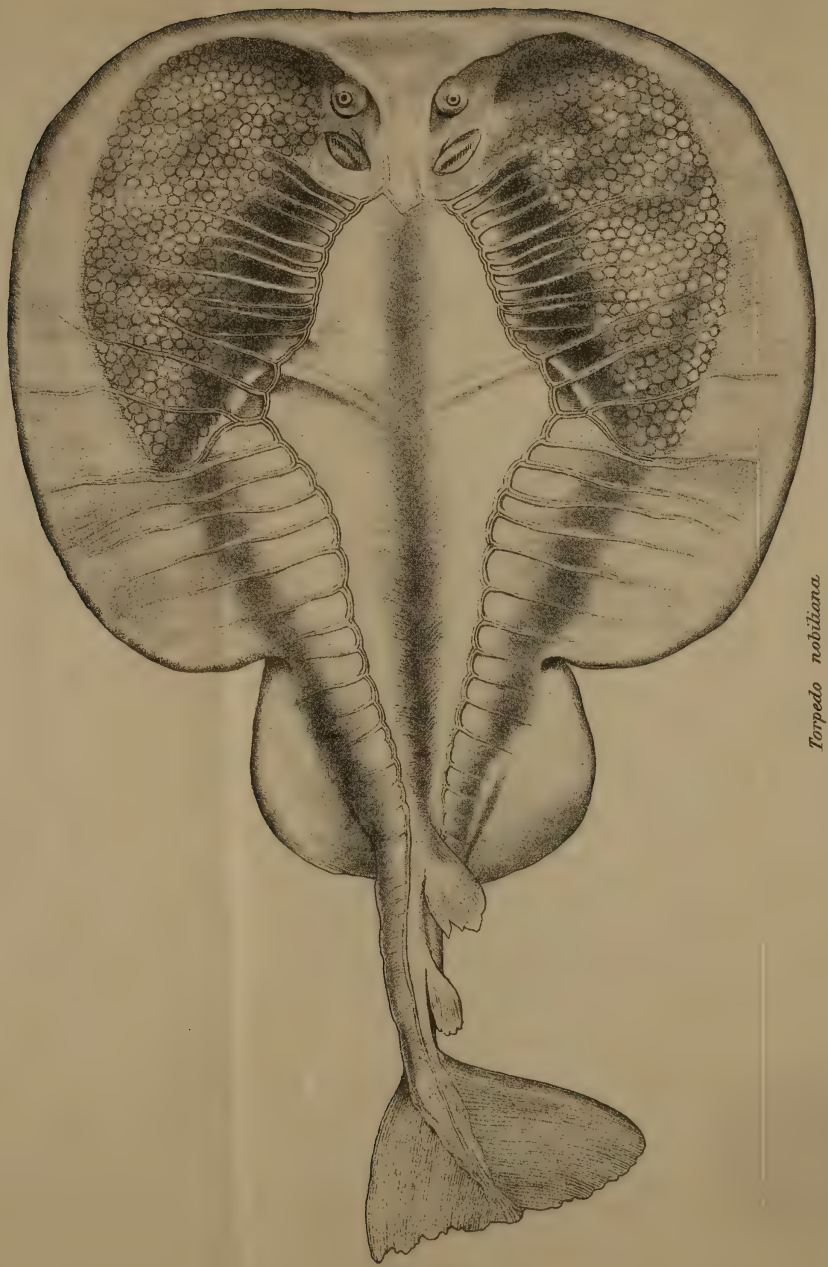
8

Lumpenus lampretæformis



Torpedo nobiliana

Serranus cabrilla.

Rhombus maximus

APPENDIX F.—No. VIII.

CIRCULARS by Fishery Board to Fishery Officers, instructing them to forward to Scientific Investigation Committee Samples of Herring and Sprats taken during Winter of 1883–4.

Fishery Board for Scotland,
Edinburgh, 10*th December* 1883.

Sir,—With reference to the scientific investigations that are now being carried on by a Committee of this Board,—

You are directed to give special attention during the present winter to the Sprat and Herring Fisheries, should there be any such going on in your district, noting daily the quantity caught, and especially what proportion of herrings there are amongst the sprats, and what proportion of herrings taken are immature (say from 6 to 7 inches in length).

You are also directed to procure and transmit, from time to time, to Professor Cossar Ewart, M.D., University of Edinburgh, samples of sprats when mixed with young herrings, and samples of full and immature herrings caught in the ordinary drift herring net. These samples should be despatched in game or other boxes by parcel post, the whole packet not to exceed 3 lbs. in weight.

You will furnish Professor Ewart at the same time with a statement in regard to the samples you send him, showing where the fish were caught, and giving such other particulars as you consider may be of use. A copy of this statement should also be sent to the Board.—I am, Sir, your obedient Servant,

Dugald Graham, *Secretary.*

P.S.—Should you have any difficulty in obtaining the boxes herein referred to, you will apply at once to the Head Office for a supply, stating the number required. These boxes can be obtained here for about 4d. each.

Fishery Officer,

Fishery Board for Scotland,
Edinburgh, 31*st December* 1883.

Sir,—I am desired to inform you that there has been forwarded to your address by the Convener of the Scientific Investigation Committee of the Board a tin case containing eight small bottles, each of which is half filled with methylated spirit; and that a second case, with similar bottles, will be sent to you shortly.

The tin cases should in the meantime be retained by you, or used for transmitting to Professor Cossar Ewart any interesting natural history specimens you may obtain from fishermen, or otherwise procure.

The small bottles are intended for the reception of the stomachs of herrings or sprats containing food of any description whatever,—whether that consists of large or small creatures or portions of creatures, and though these may have reached an advanced stage of digestion.

The stomachs, along with their contents, should be put into the bottles, and each bottle should bear a label stating—

To what kind of fish the stomach belongs ;
Size of fish ;
The depth of water at which the fish were taken ;
Character of bottom ;
The place where, and
The date when caught ; along with
Your name ; thus—

Herring, 8 in. 30 m. N.E. Wick.
20 faths. 1st January 1884.
Sandy bottom.

Fishery Officer.

A similar label, in pencil, should be put inside the bottle.

Whenever, say, six or eight of the bottles have been charged, they should be sent by you, per parcels post, in game or other boxes, addressed to Professor Cossar Ewart, University of Edinburgh, and great care should be taken to see that the bottles are securely packed.

If a large number of bottles are likely to be required by you, that fact should be at once communicated to me, unless similar bottles are obtainable in your neighbourhood at, say, 2s. per dozen, and methylated spirit at 4s. 6d. per gallon.

To further, as far as possible, the researches of the Scientific Investigation Committee, you are requested to use your utmost endeavours to obtain as many herring and sprat stomachs as you can, as well as to secure all rare and interesting fish or other marine forms which may be brought up by fishermen in your district, and transmit them to Professor Cossar Ewart, accompanied in every case by a note of whatever information you possess regarding them.

On obtaining specimens of fish and other marine objects, they should be at once placed for two or three days in a mixture of two parts of methylated spirit to one of water ; and, before packing them in game boxes or in the tin cases referred to, they should be wrapped in a thin piece of canvas or cheese cloth, which has been previously moistened with spirit.

It is hoped that ultimately special copper boxes will be provided, in which to prepare the specimens for transit.

Specimens which are small or delicate should be placed in bottles,

which will be supplied to you shortly. The bottles, when filled, should be transmitted by you in the cheapest and most convenient way.

You are directed to continue forwarding from time to time—say, once or twice a week—the samples of herrings and sprats, in terms of previous instructions.

You will acknowledge receipts of these directions on their reaching you. —I am, Sir, your obedient Servant,

DUGALD GRAHAM, *Secretary.*

Fishery Officer,

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, *9th February* 1884.

SIR,—Referring to circular letter of 31st December last, on forwarding supplies of fish for the Scientific Investigation Committee,—

I am desired to request that, in addition to the information therein called for, and which you are at present supplying to the Committee, you will, so far as you are able, include the following :—

1. Time of night or day when the fish are caught.
2. State of the weather and of the surface of the sea, and, when possible, the surface and bottom temperatures.
3. Proportion of stomachs examined which contain food.

You are also requested to obtain what information you can as to when herring and sprats or other fish feed, and whether they feed at or near the surface, or at or near the bottom, and what influence temperature, sunshine, and the weather have on their feeding and other movements.

You are further requested only to send stomachs of fish containing food.—I am, Sir, your obedient Servant,

DUGALD GRAHAM, *Secretary.*

Fishery Officer,

APPENDIX G.—No. I.

SECOND REPORT TO THE FISHERY BOARD FOR SCOTLAND.

By ARCHIBALD YOUNG, Advocate,
Inspector of Salmon Fisheries for Scotland.

CONTAINING THE

SALMON RIVERS FALLING INTO THE SCOTTISH SIDE OF THE SOLWAY FIRTH AND THE SALMON RIVERS OF AYRSHIRE.

With Map.

CONTENTS.

APPENDIX.

REPORT.

In the course of last spring I inspected the Salmon Rivers on the East Coast of Scotland, from the Forth to the Kyle of Sutherland, both inclusive, and gave in a Report upon them to the Board; and I have now the honour to lay before the Board my Second Report, which includes the Salmon Rivers on the Scotch side of the Solway Firth and the Salmon Rivers of Ayrshire, which I inspected in July and August last:—

I.—SOLWAY SALMON RIVERS.

The Esk.

The River Esk, which flows into the head of the Solway Firth, is nearly 40 miles in length, and has a catchment basin of 431 square miles. Its principal tributary is the Liddle. It rises in the parish of Eskdalemuir, and has its source in that lofty range of mountains which divides Dumfriesshire from Selkirkshire. It traverses Eskdale, enters England a few miles above Longtown, and flows through English soil until its junction with the Solway. 309 square miles of its catchment basin are in Scotland and 122 in England. It was originally included under the Solway Act of 1804 (44 Geo. III. cap. 45). But, by the 63rd section of the English Salmon Fisheries Act of 1865, it is provided, that 'the River Esk, 'together with its banks and tributary streams up to their source, 'shall be deemed to be within the limits of the Salmon Fishery 'Acts, 1861 and 1865; provided that all offences against the said 'Acts committed within Scotch jurisdiction shall be prosecuted and 'punished in manner directed by the Salmon Fisheries (Scotland) 'Act, 1862.' The Solway Act of 1804 was not expressly repealed as regards the Scotch portions of the river; but it seems to have been the intention of the Legislature to replace it entirely by the provisions of the English Acts. There is no Board of Conservators on the Esk; but there is an influential body of anglers, well known as 'The Esk and Liddle Fisheries Association,' which was inaugurated on the 18th April 1863. The revenue of this Associa-

tion is about £300 a year from rod-tickets, besides what arises from a voluntary assessment, which amounted, in 1879, to £209. The Association has done, and continues to do, much good work in preserving the river. In 1880, their Secretary stated to Mr Spencer Walpole and myself, then engaged in an inquiry into the laws affecting the Salmon Fisheries of the Solway Firth, that 'the mem-'bers of the Association do not think much change necessary in 'the existing Salmon Acts; their only grievance is the net-fishery.'

The Annan.

Unlike the Esk, the Annan is a purely Scotch river, its whole course lying within the county of Dumfries. Its length is about 40 miles, and it has a drainage area of 350 square miles. Its chief tributaries are the Evan, the Moffat Water, the Kinnel, the Ae, the Dryfe, and the Milk. It rises in a mountain range on the borders of Lanarkshire, Dumfriesshire and Peeblesshire, $1\frac{1}{2}$ miles from Tweed's Well, the source of the Tweed, and $3\frac{1}{2}$ miles from Clyde's Burn, the source of the Clyde. It falls into the Solway Firth about a mile below the town of Annan. Its name is said to be derived from a Gaelic word meaning slow-flowing. There are several mill-dams on the Annan, most of which are easily passable by salmon, when the river is in such a state as to induce them to run. But scarcely any of the lades which supply water to the various mills have hecks, and the bye-law (Schedule G) is nearly a dead letter so far as the Annan District is concerned, especially that part of it which provides that 'At the 'intake of every lade there shall be placed and constantly kept a 'heck or grating for each opening, or one embracing the whole 'openings, the bars to be not more than 3 inches apart, if horizon-'tal, and not more than 2 inches if vertical. A similar heck or 'grating shall be placed and constantly kept across the lade or 'troughs immediately above the entrance to each mill wheel. A 'similar heck or grating shall be placed and constantly kept across 'the end of each tail lade at its entrance into the main river.' After ascertaining by personal examination that this bye-law was generally neglected in the Annan District, I drew the attention of the District Board to the matter, and I have reason to believe that steps will be taken by them to have its provisions enforced in the future. The dam and lade at Newbie Mill, a mile above the burgh of Annan, are not constructed and worked in terms of the bye-law regulating 'the construction and alteration of mill-dams, or lades or 'water-wheels, so as to afford a reasonable means for the passage of 'salmon,' in so far as hecks are concerned. At Bridekirk, about 3 miles above the town of Annan, there is a bridge across the river, and a mill on each side. The lade conducting the water to the mill on the left bank is a very long one, and in many places its bottom consists of fine gravel suitable for spawning purposes. But as there are no hecks, the lade is at present a perfect salmon trap, offering great temptations and facilities to poachers. Bride-

kirk mill-dam (Mr Wilson's) has no fish-pass on it. Murraythwaite mill-dam, about 7 miles above Annan, is not a great obstruction when there is plenty of water in the river, but when the stream is low no water whatever comes over the dike. At Dormont, there is a natural reef of rocks which has been formed into a dam of considerable height, which injuriously affects from 3 to 5 miles of water above it, and it is the general opinion that the removal of this reef would produce a great improvement both on the fishings and the agriculture of the district, the latter of which suffers greatly from flooding caused by the rocky barrier damming back the water. In 1853, a negotiation was entered into for the removal of the reef, but the parties interested could not agree upon terms, and the proceedings were fruitless. At present, nearly 3 miles of water above the rocks have scarcely any fall, and are quite dead and still; and 2 miles of the river beyond this, as far up as Halleath's kennels, are partially affected by the obstruction caused by them. There are, however, some fine gravel beds and one or two streams about 3 miles above the rocks; but there is no gravel, only mud and sand, between these streams and the rocks. Were this barrier, however, removed, and a greater current of descending water thereby caused, the gravel above would probably be carried down and distributed, and the spawning grounds would thus be extended and improved. From an agricultural point of view also, the removal of the reef seems desirable, as it was stated to me that this would, to a considerable extent, prevent the flooding of between 3000 and 4000 acres of land, at present subject to damage from this cause, owing to the reef ponding back the water when the river is swollen by rain.

Although there is no serious obstruction to the passage of ascending fish on the Annan itself, when the water is high, there is a very bad weir on the Water of Milk, one of its principal tributaries, which entirely blocks up 10 or 12 miles of good spawning ground. This dam is formed of wooden planks laid close together with a beam running along the crest. Altogether, it is the worst dam in the Annan district. It was thus described by Inspector Macknight, in 1869, since which time there has been no improvement:—'The cauld is built perpendicular to about 5 feet high, then 'a slope or face is put upon that of wood about 6 feet broad, with 'a gradient of 2 to 6, and the end of said slope projects over the 'cauld or perpendicular part about 12 inches, and the water in 'the ordinary size of the river, when flowing over the cauld, 'sinks amongst the wood, so that it is mostly dry, and, conse-'quently, it is utterly impossible for fish to ascend the cauld, except 'when the river is in very high flood. A strong fish may get over 'at the end. But there is no pass or ladder, and the cauld is so 'constructed as to be a complete barrier and obstruction to the run 'of salmon either on the ascent or descent. There is an intake 'sluice into the mill-lade, but no heck or grating.'

If a V-shaped cut was made in the crest of this dam about 30 feet from the left bank of the stream, it would probably enable running fish to ascend to the upper waters. There is another weir on the Water of Milk below this one. It is formed of rough stones,

is about 3 feet high, and is not much of an obstruction. But it has a very long lade, and there are no hecks except one above the mill wheel.

It is a mistake, I venture to think, to allow a comparatively small river like the Annan to be worked by the sweep net for commercial purposes above the point to which the tide ascends. Yet at present the lower reaches of the river are so worked. They would pay better, I believe, if let for angling; and I understand that an Angling Association has recently been formed at Annan which might possibly find it well worth its while to lease the river nets for the purpose of removal. The success of the Dee Fisheries Improvement Association in Aberdeenshire might encourage them to make an effort. That Association have leased and removed the nets on about 15 miles of the Dee with the happiest results to the river fishings, so that, with the rod alone, 5000 salmon and grilse were killed, in that river, in 1882 and as many in 1883.

Connected with the Annan by a tunnel are the Lochmaben Lochs, eight in number, four of which communicate with the Annan. The largest of these is the Castle Loch, which covers upwards of 200 acres and contains 15 kinds of fish, including trout, roach, chub, perch, pike, and the Vendace. Pike have been caught weighing 35 pounds. The Vendace are fished for once a year by the Vendace Club, an association of Dumfriesshire gentlemen. The Vendace (*Coregonus Willughbeii* or *marœnula*) belongs to the family Salmonidæ. It is accounted a great delicacy, and, in this country, is found only in two of the Lochmaben Lochs, the Castle Loch and the Mill Loch. It is never taken by the fly, but is captured by means of a net. It is esteemed a great delicacy for the table. It breeds generally, but not invariably, about the middle of November. Its colour is greenish blue along the back and upper half of the body, silvery dashed with gold along the sides and beneath. Fins rather dark. It attains a length of from 9 to 10 inches.

The Annan, like almost all the rivers on the Solway and on the west coast of Scotland, is a late river. Under the Solway Act of 1804 and the Annan Act of 1841, its annual close time was from the 25th day of September to the 10th day of March in the year following. Under the Salmon Fisheries Act of 1862 this was altered, and the close time was fixed from 27th August to 10th February, with extension of time for rod fishing from 27th August to 31st October; and quite recently this has been again altered under the 9th section of 'The Salmon Fisheries (Scotland) Act, '1868,' by Order under the hand of the Secretary of State, and the close season is now from 10th September to 24th February, with extension of time for rod fishing from 10th September to 31st October.

The Kirtle.

About seven miles eastward of Annan, within the Annan Fishery District, is the little river Kirtle, 17 miles in length. At present it is more a sea-trout than a salmon river. But it might be made

to hold salmon and grilse, if the dams which obstruct it were rendered passable for fish. The lowest of these is at Redkirk. This is a very steep dam, nearly 6 feet in height, and with a sloping face or apron of only 13 feet, or a gradient of almost 2 horizontal to 1 perpendicular. There is no pass or ladder of any kind. A subsidiary dam should be made from the bridge to the fourth timber strut on the dam, or at the narrowest point of the river a little below the bridge. A diagonal board along the face of this weir might possibly enable salmon to ascend, and it would be less expensive than a subsidiary dam. It would not, however, be so effectual. There is no heck on the lade leading from this dam. There is some good spawning ground between Redkirk and Beltenmont Mill higher up the Kirtle. The dam at Beltenmont is a great obstruction, and only sea-trout can get up beyond it. Its lower step is covered with wooden planks to supply the place of the rough stones that have fallen out. The late Mr Frank Buckland wrote as follows about this dam in 1871:—'The weir at Beltenmont is exceedingly 'difficult to ladder; the only chance is to go round by means of a 'semi circular cut or trough made in the west bank. This should be 'made of boards fixed into the earth, and so arranged that when 'the hatches of the mill are shut the water should go down the 'pass, and not over the weir.'

There is no heck on the lade connected with this dam, and the bottom of the lade is all fine spawning ground. Above Beltenmont is Kirtle Bridge Mill. The dam belonging to this mill offers a serious impediment to ascending fish. It is fully 5 feet in height, and the length of the slope or apron of the dam is only 10 feet 5 inches. There is a deep pool beneath. For the purpose of enabling fish to surmount this obstruction, a subsidiary dam 3 feet high might be constructed 41 feet below the main dam, beginning at a fragment of old wall on the right bank. The channel of the stream is here 40 feet wide. There is no heck on the lade from this dam, which supplies two mills.

Salmon Fishings in the Annan District.

The value of the salmon Fishings in the Annan District has increased steadily, if not rapidly, since the passing of the Salmon Fisheries Act of 1862, as the following statistics will show. In 1864, the value of the sea fishings was £673, and of the river fishings £111, 14s. In 1870, the value of the former was £1100, 10s.; and of the latter £112, 4s. During the three years 1877–1879, both inclusive, the yearly value of the fishings had risen to £1371, 18s. 6d., of which there was spent in watching, prosecutions, &c., £792, 6s. 8d. In 1880, the yearly value was £1391, 10s.; in 1881, it was £1718, 10s.; and in 1882 £1719, 12s. 8d., of which £1543, 2s. 8d. belonged to the nets, while the value of the angling waters was only £176, 10s. During these three years, 1880–1882, both inclusive, £1013, 2s. 4d. was spent in watching, prosecutions, &c. The valuation for the past season is £1864,

5s. 8d. The assessment levied by the District Board has for many years been at the rate of 4s. per £1, except in 1879, when it rose to 6s. per £1. The cost of prosecutions for the six years 1877 to 1882, both inclusive, was £321, 1s. 5d. and the fines recovered amounted to £259.

Great complaints were made by the Annan District Board of the whammel or drift net boats, which fish for salmon without a title on the Scotch side of the Solway Firth; and also of the sparling nets. In his Report, dated 27th July 1883, Inspector Thorburn writes as follows:—

'*Drift Net Fishing.*—There are now 28 boats and nets of this 'description licensed by the Eden District Board to fish for salmon 'in the Solway. There are four or five men appointed to each 'boat, while only one, and never more than two, are required to 'work the boat at one time, so that the boats can be kept 'continually at work by a change of men.

'Although these men and nets are licensed to fish in the Eden 'district they fish very little in that district. The most of their 'fishing is done in the low water channel, and in the Scotch side of 'it. This has given a great deal of trouble and annoyance for 'several years, and the great difficulty is that parties who commit 'offences in the Annan District in Scotland cannot be prosecuted 'and convicted under the Annan Act.

'There are also a great number of haaf net fishers on the 'English side, and many of them come through the channel at low 'water and take possession of the Scotch side of the channel. 'These Englishmen defy the men who have a right to fish on the 'Scotch side, and have even taken fish from before their nets, and 'were the Scotchmen to attempt resistance a serious breach of the 'peace would be the result. Many cases of this kind have been 'reported, but there is no remedy, and, as things are at present, the 'Englishmen have possession of the Scotch half of the channel, 'which is left wholly unprotected.*

'*Sparling Fishing.*—A number of men and boats fish for 'sparlings every year, commencing in the month of August and 'continuing through the winter, unless stopped by hard frost. The 'sparling net is so small in the mesh that it takes the smallest of 'fry, and it is used only in the low water channel and mostly 'during the night time. Great numbers of salmon and herling 'are taken in these sparling nets, and although several convictions 'are got every year against the parties who use them, there is great 'slaughter of salmon during the close season which is most difficult 'to get at. If those nets cannot be put out, there should be some 'law to prevent them being used in the low water channel, and 'during the night when they cannot be seen. The sparling fishers 'go out under the pretence of fishing for sparlings, while it is well 'known that all the sparlings that are got in the district would 'not pay the men for one boat, and sometimes there are from six

* The remedy for this is to repeal the 14th section of 9 Geo. IV. cap. 39, when the men could be prosecuted under the 25th section of 'The Salmon Fisheries (Scot-'land) Act 1868;' which section, unfortunately, does not at present apply to the Solway.

'to a dozen boats at that sort of fishing.* A uniform weekly and 'annual close time for both sides of the Solway should also be 'taken into consideration.'

There are 34 fixed engines, with 126 pockets, employed in fishing for salmon in the Annan District; only 4 fixed engines, with 17 pockets, having been disallowed by the Special Commissioners in 1879. They granted certificates of privilege to the remainder.†

Two reforms on the existing Salmon Fishery Law were strongly pressed upon me in the Annan District, as they afterwards were in the districts belonging to the other rivers flowing into the Scotch shore of the Solway Firth, and these reforms are so necessary and so urgent that I have no hesitation in recommending that they should be given effect to. They were recommended by Mr Buckland and myself in our Report of 1871, and again by Mr Walpole and myself in our Report of 1881. There are great differences of opinion on many points between upper and lower proprietors on the Solway, as elsewhere in Scotland, but I have never yet met with any difference of opinion concerning the necessity of, *in the first place*, making the 25th section of 'The 'Salmon Fisheries (Scotland) Act, 1868,' applicable to the Solway Firth; and, *in the second place*, empowering the authorities, either in England or Scotland, to prosecute persons fishing for salmon without a proper title in the low water channel of the Solway Firth, and also giving authority to the Sheriffs or Justices in any of the counties bordering on either side of the Firth to issue warrants to cite offenders resident in another of these counties. Owing to the want of such a power at present, it is in many cases almost impossible to prosecute and convict offenders. The Solway Firth is in the position of a boundary river between England and Scotland, and there seems no reason why a power similar to that conferred by the 35th section of the Act of 1868, in the case of boundary rivers between counties in Scotland, should not likewise be conferred on the Sheriffs and Justices of the Peace in the counties of Dumfries and Wigtown, the Stewartry of Kirkcudbright, and the county of Cumberland.‡ With regard to the other reform recommended, namely, the making the 25th section of the Act of 1868 to apply to the Solway Firth, that section is as follows:—'In order the better to carry out the pro-'visions of the Act of the 7th and 8th years of Her present Majesty, 'chapter 95, it shall be lawful for any water bailiff, constable,

* It should be made illegal to fish with nets of this kind between sunset and sunrise. That would give sufficient time to take all the sparlings to be got in the Firth, as sparlings are generally found in shoals, one hole or pool swarming with them, while in the next deep water there are none. Hence, the time named is quite sufficient to take all the sparlings to be found either in the Firth or the rivers; and if the men fished during daylight only, it would be easy to see what they were killing.

† See Appendix, No. I., namely, 'State showing the result of the Proceedings of 'the Special Commissioners for Solway Fisheries in regard to the fixed engines in the 'Solway, and in the Rivers flowing into the same, 1879.'

‡ In our Report of 1881 on the 'Laws affecting the Salmon Fisheries of the Solway 'Firth,' Mr Walpole and I write as follows upon this subject:—'Grave inconve-'nience arises from the fact, that a summons issued in England is not serviceable in 'Scotland, and *vice versa*. This alteration of the law, however, is, we believe, 'required on general grounds, and ought not to be confined to Salmon Fishery 'purposes.'

'watcher, or officer of any District Board, or any police officer, to 'search all boats, boat-tackle, nets, or other engines, and all recep- 'tacles whether at sea or on shore, which he or they may have 'reason to suspect may contain salmon captured in contravention 'of the said last mentioned Act, and to seize all salmon found in 'the possession of persons not having a right to fish salmon, and 'the possession of such salmon shall be held *prima facie* evidence 'of the purpose of the possessor to contravene the provisions of 'the said last mentioned Act. Provided also that the words "the '"said recited Act" shall be read, and construed as if they meant 'and included this Act and the Acts recited therein.' Unfortunately, the above quoted section does not apply to the Solway Firth where fishing by hang, or, as they are there called whammel nets, is very common and destructive. The reason why this section cannot be enforced on the Solway is as follows:—It is an amendment of 7 and 8 Vict. cap. 95, but that Act is itself an amendment of 9 Geo. IV. cap. 39, the 14th section of which declares 'that nothing in this Act contained shall extend or be construed 'to extend to the fisheries in the arm of the sea between the county 'of Cumberland and the counties of Dumfries and Wigtown, and 'the Stewartry of Kirkcudbright, or the fisheries in the several 'streams and waters which run into, or communicate with the said 'arm of the sea.' As before stated, almost all the proprietors and tacksmen of salmon fishings in Dumfries and Galloway are in favour of making the 25th section of the Act of 1868 extend to the Solway, where, as the law at present stands, the authorities have no power to put a stop to the ravages of the whammellers in the low water channel of the Firth. Mr Jones, Chief-Constable of Dumfriesshire, who has the charge of the protection of the Annan and Nith, thus describes the operation of whammel and sparling nets:—

'*Whammel Nets.*—About 20 years ago two men from the 'English coast came into the Annan district, and brought with 'them an open boat and net. These men immediately began to fish 'in the low water channel of the Solway, from Annan Waterfoot, 'at the head of the Newbie fishing grounds, for several miles 'downwards. They operate thus: They fold the net in the stern 'of the boat; when three-quarter ebb they lay the net out behind 'them as they run across the channel until the net is fully laid out. 'They then allow the net to float down channel, and when a fish 'strikes the net it gets its head through a mesh, and so is taken or 'hanged. The end of the net farthest from the boat is fastened to 'a stout post so loaded as to keep it upright, and the net has 'sinkers on the one side and floats on the other. This operation 'is continued till close on low water, and, when the tide begins to 'flow, the net is in the same manner floated upwards, and the work 'continued until about one-quarter flood, at which time the tide has 'got pretty well over the bank. The success of these men 'encouraged others; and during the last three or four years, not 'fewer than about twenty boats have been so employed, not, 'perhaps, every day, but whenever there is an appearance of a run of 'fish. In ordinary states of the water, there are seldom fewer than 'from ten to twelve boats so employed every tide. The ground of

'their operations is much extended, as they now work in the low-'water channel a good way to the east of Annan. *The nets are* '*from about* 300 *to* 800 *yards long, thereby enabling each boat-fisher* '*to all but cover the channel at low water;* consequently, it is impos-*'*sible for a fish from three-quarter ebb to one-quarter flood to escape,* '*thus showing that if fish are not all killed in the low-water channel,* '*they are entirely impeded from entering the rivers. This system of* '*fishing is most destructive to the rivers, as the fish are taken that are* '*gathered at low water for the very purpose of entering them.*

'*Sparling Nets.*—This net is used in the low water channel when 'the tide is out. It will be about 100 yards long, and from 6 to 9 'feet deep. It has sinkers and floats the same as an ordinary 'draught net, and is fished with the aid of a boat in the same way. 'The mesh is very small—only about half-an-inch from knot to 'knot. The sparlings are from 6 to 9 inches long, and the net is 'capable of taking anything that size out of the low water channel. 'Generally speaking, the men who use the whammel net during 'the summer are the parties who use the sparling net. They 'begin operations in the end of August or beginning of September, 'and continue them throughout the winter. *I believe that all the* '*sparlings killed in the Solway would not yield wages to one man* '*during the winter, and yet there are from twenty to thirty men with* '*boats ostensibly fishing for sparlings; but it is quite well known* '*that they take quantities of salmon on their way to the rivers to spawn.*'

The other nets used in the Annan District are the haaf or halve net and the paidle net. The haaf net is something like a large shrimp net, held by the fisherman while he is fishing. The haaf net fishermen often fish in numbers just where the Annan joins the sea, one man to each net. Salmon enter the mouth of the river with the flow of the tide and return with the ebb. The haaf net fishers face the flow with their nets, and so either take the fish or impede their run into the river. When the tide turns they face the ebb, and take the fish then returning to the sea, doing so chiefly at low water mark. From the number of men employed daily in this way, the take must be very considerable. The Eden Board of Conservators issue licenses to fish with the haaf net at £2, 10s. each, and the burgh of Annan grant leave to fish with the haaf net at £1, 10s. for the season.

The Paidle net, now in use on the Solway, is simply a small stake net calculated to take salmon under pretence if catching flounders. It is thus described by Mr Jones:—'It has a flood arm, 'a cross-arm, and an ebb arm, and a pocket with coops the same 'as an ordinary stake net for salmon. Sometimes some of them are 'joined so that they often embrace a large portion of the fishing 'ground between low water and high water mark. These nets are 'set in great numbers, and under the pretence of taking white fish, 'but the real object is to take salmon. The general height of the 'arms is from 5 to 7 feet, and the nets are set during the winter 'and very frequently in the summer season. *During the winter*

* Mr Jones suggests that it would be desirable to restrict the length of these nets to 300 or 400 yards, and to prohibit their use within a considerable distance of the entrance to any river at low-water mark.

'*months, when the salmon nets are removed, these nets are set in* '*increased numbers, and take great quantities of salmon.*'

With respect to these Paidle nets, I beg to state that I adhere to the recommendation made by Mr Spencer Walpole and myself, in our Report of 1881, on the laws affecting the Salmon Fisheries on the Solway Firth. We then wrote as follows (page 13): —'We are inclined to think that the Legislature should regard with 'great jealousy the erection of any new fixed nets in the Solway 'Firth, and we recommend that all Paidle nets to the east of the 'old house of Carsethorn of Arbigland should be declared illegal.'

Even a reduction in the height of these nets to 3 or 4 feet, as has been proposed, would not be sufficient to prevent them from killing salmon. And upon this point I am glad to be able to cite the opinion of Mr Jones, whose acquaintance with everything connected with the Salmon Fisheries in the Solway is both extensive and accurate. He writes as follows:—'Paidle nets 3 to 4 feet 'high, having the usual pockets, will take salmon as well as those 'of a larger size. It depends more on where they are set than on 'their height. As it is almost wholly flat fish, such as flounders, '&c., which the fisherman say they use these nets for, no pockets 'are required, as it is principally with the ebb tide, when flounders 'back off the feeding grounds and are caught in these nets, and as 'these fish all swim close to the bottom, if a net of not more than '3 feet high were erected in the form of a large V, without any 'pocket, it would catch as many flounders in proportion to the 'quantity of net used as any Paidle net will do, and even that net 'should only be allowed on banks or scaurs, not in runners or 'channels. Further, two men with a boat and flounder trawl-net 'will catch more flounders in one tide than all the Paidle nets on 'the shore, and not a salmon would be caught in it therefore, the 'Paidle nets, as used, are not the proper or best mode of taking 'white fish.' Mr Jones further writes on the subject of these nets:—'If the 14th section of 9 Geo. IV. cap. 39, were repealed, 'the 25th section of 27 and 28 Vict. cap. 118, "The Salmon 'Fisheries (Scotland) Act, 1868," including 7 and 8 Vict. cap. 95, 'would then apply to the Solway, the latter of which makes it an 'offence to wilfully take salmon, &c., within a mile from low water 'mark; and as the 25th section of "The Salmon Fisheries (Scotland) 'Act, 1868," provides that all nets, &c., may be searched, and if 'salmon are found in possession of persons not having a right to fish 'for salmon, the possession of such salmon shall be held *primâ facie* 'evidence of the purpose of the possessor to contravene the pro- 'visions of the last mentioned Act. Therefore, salmon, &c., found in 'the possession of any person fishing with Paidle nets, not having 'a right to take salmon, would be an offence, and would soon put the 'Paidle nets out of existence without any farther proceedings.'*

It will be seen, on reference to the Memorandum by the Special Commissioners on the Solway (Appendix No. II., page 137), that they were clearly of opinion that these Paidle nets were set and used

* See further on the subject of these nets, 'Memorandum by the Special Commis- 'sioners of Solway Fisheries as to their Proceedings under the Act 40 & 41 Vict. 'cap. 240.' Appendix, No. II. pp. 53, 54, 57, and 58.

for the purpose of taking salmon, and were illegal, because their owners had no title to fish for salmon. They write as follows with regard to them :—'Those using these nets admitted that they had no 'right to fish for salmon, and they claimed no certificates of privilege. 'In these circumstances it was contended by them that the Solway 'Salmon Fisheries Commissioners had no jurisdiction to entertain 'the complaint of Mr Mackenzie. Being directed by Sec. 3 of the 'statute under which we were appointed "to inquire into the legality 'of all engines erected *or* used for taking salmon," we held that we 'were bound to hear the evidence tendered; and having heard it, 'were satisfied of the truth of the allegation, that they were erected 'and used for the taking of salmon, and therefore we ordered to be 'removed such of them as we had seen at the period of our visit to 'Annan. The nets are simply small stake nets of the same general 'form as the ordinary salmon stake nets, with covered pockets, and 'the ground selected for fixing them is precisely of the same kind as 'that chosen for the ordinary salmon nets. They are much higher 'than the poke nets above referred to, and hardly lower than some 'avowedly salmon nets fixed elsewhere, but they are much lower 'than the salmon stake nets used in Mr Mackenzie's fishings. They 'are set as near low-water mark as they can be securely fixed. On 'appeal, the Second Division of the Court of Session, without looking 'at the evidence, declined to interfere with the deliverance of the 'Commissioners, who, they held, had a clear statutory duty which 'they were bound to perform.'

In a recent case brought before Sheriff Hope at Dumfries with regard to these nets, the Sheriff found, by interlocutor dated 7th December 1883, that the nets complained of are injurious to the salmon fishings, and are of an illegal nature, and that the respondent David King or Kean, fisherman, Powfoot, Cummertrees, is not entitled to erect any nets of that description *ex adverso* of the lands in the Annan District belonging to the petitioners, the Duke of Buccleuch, Sir Frederick Johnstone, and E. D. Mackenzie, Esq. of Newbie.

The Nith.

The Nith rises in lofty hills not far from Dalmellington, in Ayrshire, traverses Nithsdale, and joins the Solway about 3 miles below the town of Dumfries, after a course of 50 miles. It has a drainage area of 435 square miles. Its chief tributaries are the Cargen, the Cluden, the Scaur, the Shinnel, the Menock, the Carron, the Cample, &c.

Besides salmon and trout, the Nith contains a good many graylings, which occasionally grow to a weight of 3 pounds. They are in season in winter. They do not, in general, rise freely to the fly. Very large salmon have occasionally been taken in the Nith, and one of the heaviest ever captured by the rod was caught in 1812 in that part of the river belonging to the estate of Barjarg, by an old poacher of the name of Jock Wallace, who was celebrated for never having done a hand's turn of work in his life, except cutting his own firewood, which he generally did in other people's plantations. The

salmon was hooked about eight in the morning in a pool called the 'Clog,' and was gaffed in the 'Boat Pool of Barjarg' by some men coming home from their work at six in the evening. It was then found that only two hairs of Wallace's casting line remained. The salmon was taken to Barjarg Tower and weighed immediately afterwards in presence of the proprietor, Mr Hunter Arundell, who, along with some other persons who were present, signed a certificate of its weight, a copy of which is now in the possession of his son, the present proprietor of Barjarg. The weight of this monster was 67 pounds.

On the Nith and its tributary streams there are 22 dams, of which 8 on the tributaries vary from 8 to 20 feet in height, and of course, form absolute obstructions to the passage of salmon. The lades in connection with 17 of these dams have no hecks at the intake or tail lade, and fish-passes or ladders are chiefly conspicuous by their absence.

The Cargen Water falls into the Nith about 2 miles below Dumfries. Salmon of 30 pounds weight have been seen on this water as high up as Glen Mills. Above Glen Mills there used to be a perpendicular dam built across the stream about 8 feet high, constituting a complete obstruction. But three years ago, a gap 10 or 12 feet wide was made in this barrier by a flood and ice, which has not since been repaired, greatly to the advantage of the fishings. The Cargen is a good trout stream.

The Cluden Water is the principal tributary of the Nith, and, both as regards salmon and trout, it is superior to the main stream. Yellow trout have been got as large as 4 pounds. They are thick deep fish, and dark in colour, but cut pink. Up to Cluden Rocks, a distance of 4 miles from its junction with the Nith, the Cluden is unobstructed, then comes the natural barrier known as the Cluden Rocks, which block up about 8 miles of river and a large extent of fair spawning ground. About the centre of this natural barrier, but rather nearer the right bank, it would be easy to make a passage so as to facilitate the ascent of the salmon, which at present are detained below the rocks, and scooped out of the deep pool just below the mill wheel. This pool extends a long way under the rock, whose shelves and ledges project over it. It is fished by means of a peculiar net, stretched between two poles, 10 or 12 feet long. This is worked by two men and is thrust into the pool, which it searches thoroughly. In 1881, no fewer than 400 salmon and grilse were taken out of this pool, and as many as 56 have been captured in a single day.

The Macdonald Fishway.

With reference to the cheapest and most effectual way of enabling salmon to surmount such obstructions as the Cluden Rocks, and the other natural and artificial obstructions hereinafter described, I may mention that the merit of being the best pass in the world is claimed for the 'Macdonald Fishway,' which was shown last year in the United States department of the London International Fisheries Exhibition. A company, termed 'the

'Macdonald Fishway Company,' has been formd at Washington to work it, and it has been patented in Canada, Great Britain, and Ireland. Several Fishways contructed on this principle are said to be working successfully in New York, Georgia, Carolina, and other States of the American Union; and plans are at present being prepared for enabling fish to ascend the great falls of the Potomac River, which are 72 feet in height. It is stated that the gradient of the Macdonald Fishway may be as steep as 1 in 3 or 1 in 4, and that the cost varies from 10 to 25 dollars per running foot of Fishway; that is to say, a dam or a waterfall, 8 feet in vertical height, would require a Fishway not longer than from 24 to 32 feet. This is an immense improvement on any fish-passes which have been constructed in this country—none having hitherto proved successful with a steeper gradient than 1 in 8 or 1 in 9; that is to say, a dam or waterfall, 8 feet high, has hitherto been found to require a fishway from 64 to 72 feet in length. It will thus be seen that the Macdonald system shortens the length of the fishway by more than a half, and so effects a great saving of expense. The management of the current of water in the Macdonald Fishway is also novel and peculiar. The last great fish-ladder constructed in Scotland is that at the Falls of Moriston, erected to enable salmon to ascend from Loch Ness into the River Moriston. The Falls are about 24 feet high. The ladder has a gradient of 1 in 10, being 240 feet long, and has cost £1800. But, according to the Macdonald system, the Fishway would have been only 96 feet long, and would have cost from £192 to £480. If, therefore, what is stated of the Macdonald system be correct, it is obvious that it would be of great importance to have it applied, not only to the natural and artificial obstructions in the Nith District, but likewise to those in other Fishery Districts in Scotland, where far greater stretches of good spawning-ground would be opened up, by enabling salmon to ascend waterfalls which they are at present unable to surmount. At this moment, there are upwards of 500 miles of rivers and lochs in Scotland, wholly or partially closed against salmon by natural obstruction; the chief of these being the Falls of Tummel in the Tay District and the Falls of Mounessie in the Lochy District, the former obstructing upwards of 100 miles of water, and the latter 40 miles. The Macdonald Fishway Company, who have been applied to by the Tay District Board, state that a pass over the Falls of Tummel, which are 16 feet high, would require a Fishway 64 feet long, which could be constructed at a cost of from £100 to £250, depending upon the difficulties of the site, the strength of construction required, and the cost of the substructure or foundations, which will vary between very wide limits. Then there are Craigo dam, the 'Burn Loup,' and the 'Loup of Edzell' in the North Esk District; the Falls of the Conon, in the Conon District, which bar 20 miles of river and half-a-dozen considerable lochs; the Falls of the Kirkaig and the Falls of the Polly in Sutherlandshire, the former of which shuts up several miles of river and a chain of great lochs stretching from Sutherland into the borders of Ross-shire, and the latter of which prevents the ascent of salmon into several miles of river and 11 lochs, one of

them 12 miles in circumference. Such are some of the obstacles which might be overcome by the instrumentality of the Macdonald Fishway, if what is stated of its cheapness and efficiency by its promoters shall turn out to be correct.*

There is a very injurious dam on the Scaur Water, one of the best spawning tributaries of the Nith. Its face is perpendicular. It is partly formed by impassable rocks, and partly constructed of wood, and it is so steep and lofty that, even when the water is high, there is only one place on the right bank where fish can get up, and that with difficulty. This dam to a great extent blocks up 10 or 12 miles of water, much of which is eminently suitable for spawning purposes. When the river is low, most of the water is carried off by the lade which supplies the mill connected with this dam. I was informed that one of the best angling years ever known on the Nith occurred about ten years ago, when a great breach had been made in it by floods.

A mile farther up the Scaur, there are two waterfalls about 50 yards apart, the uppermost of which is 6 feet in height. These falls detain, though they do not entirely arrest, ascending fish when the water is high, and they offer great temptations and facilities to poaching, as there are deep pools below the falls where the fish lie, and where they can be easily taken out by 'sniggling' with a large treble hook. It would be easy, and would cost but little, by means of a charge or two of dynamite, to make these two falls easily accessible to fish; and, in my opinion, this ought to be done.

At Shinnel Mill, there is a dam which forms a complete obstruction. It is 6 feet high, and perpendicular; there are no hecks on the lade; there are several miles of good spawning ground above. Aird's Linn, about 2 miles above the junction of the Shinnel with the Scaur, is impassable at present; but the rocks might be easily blasted so as to let fish up. At Closeburn Mill there is a long lade without hecks. This mill is supplied with water from Crichope Burn, a tributary of the Cample, and Cample woollen mill is driven by the same lade that supplies Closeburn Mill. At Closeburn Mill there are two wheels—one outside and one inside the mill—and two tail-lades, one from each wheel. The water is carried on wooden troughs down to Cample Mill, and from these there is a wooden shoot which serves as a byewash, and by which the whole water might be entirely turned off. The Scaur, Shinnel, and Cample are all good trouting streams. But the Carron is still better, consisting entirely of spring water; the trout in it are firm, well-shaped, and pink-fleshed, but they seldom exceed a pound in weight. At Morton Mill, Carron Foot, near the junction of the Carron and Nith, there is no heck at the tail-lade. Most of the water in the stream is taken off by the lade. Not a drop of water was coming over the crest of the dam above the saw-mill on the Carron when I visited it; and as the dam is 10 feet high, it is an absolute obstruction, blocking up about 8 miles of

* A full account of the 'Macdonald Fishway,' illustrated by diagrams, will be found in the well-known New York paper *Forest and Stream*, of 3d and 10th January last.

good water above. As usual, there are no hecks on the lade which takes away the greater part of the water in the river. At Holestane, the Duke of Buccleuch's farm-steading, about a mile and a half above the saw-mill, there is another impassable obstruction on the Carron, partly natural and partly artificial, and nearly 20 feet high. There is a long deep pool below it. Here there is a heck at the intake lade. Just above the junction of the Enterkin Burn with the Nith, there is another impassable dam dike 10 feet high. There is a heck at the intake, but none at the tail-lade. On the Menock, a larger tributary, there is a wooden dam 12 feet high, which, of course, forms a complete barrier to the upward progress of fish. It shuts out five miles of spawning ground.

The best salmon water on the Nith—a succession of fine streams and pools—is situated between Nith Bridge, near Thornhill, and the town of Sanquhar. Of this, the Duke of Buccleuch reserves for himself the portion from Enterkin foot to Nith Bridge, or about six miles of capital angling water. But, with praiseworthy liberality, he gives the Angling Association of Upper Nithsdale, whose head-quarters are at Sanquhar, permission to fish from Enterkin foot up to the boundary of Dumfriesshire; and he likewise grants leave to the Mid-Nithsdale Angling Association, whose head-quarters are at Thornhill, to fish in the Nith from Nith Bridge down to the boundary of the Duke's estate, and also in the Scaur, Cample, and Shinnel.

On the Crawick water, a considerable stream which joins the Nith near Sanquhar, there are a forge and spade manufactory, a grain mill, and a blanket mill, all worked by lades from the river. The bye-law with regard to hecks is not duly observed in any of them, as, though there are hecks above the mill wheels, there are none at the intake or tail-lades. Indeed, it may be said that, throughout the Nith district, the bye-law with regard to mill-dams, lades, and hecks, and the well-known case of Kennedy *v.* Murray, 8th July 1869, which declared and established the validity of that bye-law, are almost entirely ignored. In that case the Court of Session held (1), That the Salmon Fishery Commissioners, acting under the Act of 1862, have power to make bye-laws applicable to lades, dams, &c., whether in process of being constructed or repaired or not; (2), By a majority of the consulted judges, that the Commissioners have also power to impose an obligation on the owners or occupiers of mills to execute at their own cost the works embraced in the bye-laws so made. This decision has unquestionably greatly strengthened the hands of District Boards; and where such Boards exist, they ought to have no difficulty in enforcing, and no excuse for not enforcing, the provisions of the bye-law.

In the River Nith and estuary, there are a great number of Paidle nets, which have been already described, ostensibly set up to take white fish, but which really do take a great number of salmon. A list of these nets, in May 1883, will be found in Appendix No. IV.

From an examination of this list, it will be seen that there are no fewer than 109 of these Paidle nets, fishing in the estuary

of the Nith, licensed to fish for white fish, but which must and do catch salmon, to the great detriment of those proprietors who have a title to salmon fishings in the district of the Nith. I find, on comparing the above list with a list for 1880, that there has been an increase of 11 Paidle nets since that year. In that year there were 98, whereas, in 1883, there are 109. These nets have greatly increased since the decision in the case of Neilson *v.* Fenton, 16 Nov. 1876—Couper, vol. iii. p. 353—in which it was held that section 9 of the Solway Fisheries Act, 1804, prohibiting persons not owners or occupiers of fisheries from taking salmon, &c., without being duly authorised, did not apply to a person holding a licence from a fishing proprietor on the Solway to fish with stake nets for white fish, who, while so fishing, captured and took salmon; and a conviction of such a person before the Justices of the Peace, under the said section, was accordingly set aside. The Nith District Board state that the effect of this decision has been entirely to paralyse their hands in dealing with the owners of these Paidle nets, who can now, without a shadow of a title to fish for salmon, capture and appropriate these fish with impunity. The decision in Neilson *v.* Fenton, was a Justiciary case. It has been suggested that a civil action of declarator and interdict directed against these nets as being fixed engines within an estuary used for the killing of salmon, and used by persons without a vestige of a title to fish for salmon, might yet have the effect of putting a stop to their operation, so far as salmon are concerned. In the Appendix to the Report of 1871, on the effect of recent legislation on the Salmon Fisheries in Scotland, drawn up by Mr Buckland and myself, Mr Buckland writes as follows about these Paidle nets in the Nith:—'Paidle 'nets are very destructive to salmon. There are, I understand, 'about 40 of them fishing at and about the mouth of the Nith, and 'entail a great deal of watching on the part of the water-bailiffs. 'The plea always given for their use is that they are set for 'flounders, and flounders only. They are covered with a roof of 'netting, so that if a salmon once gets in he cannot get out again. 'Of late years, the leaders to these nets have been made taller and 'taller; they are now, by my own measurement from 5 to 7 feet 'high; 3 feet would be quite enough to drive the flounders into the 'nets. Paidle nets should be done away with altogether, as the 'flounder fishing is most insignificant as compared with the 'salmon fishing.' The effect on the salmon fishings of so many ranges of small stake-nets as those above enumerated, fishing within the estuary of the Nith may be imagined, especially when it is taken into consideration that these nets are in fishing order during the weekly close time, and take salmon on Sundays as well as on week days. It should be stated that Lord Herries, who is the owner of the Fishing, on which 89 of these paidle nets are placed, would have no right himself to use fixed engines for the capture of salmon within the estuary of the River Nith, this having been decided in the case M'Whir *v.* Oswald, 13th April 1835.

When in the Nith District, I took a boat and carefully inspected a number of these nets at low water. In the pocket of one of

them I saw two salmon, and from their position, construction, and arrangement, I have no doubt whatever that they must take and do take salmon, whenever there are salmon in the estuary of the Nith.

The Nith is a very late river—one of the latest in Scotland—very few clean fish being seen in it until May or June. This was recognised two centuries ago, as the following Act, passed during the reign of Charles the Second (1681, c. 101) shows :—'Act anent 'the Salmond fishing in the Water of Nith. Our Soveraigne Lord, 'considering that the slaying of Salmond in forbidden time is 'charged by several Acts of Parliament, and that the Salmond 'fishing within the Water of Nith doeth differ much from any 'other Salmond fishing within this Kingdom, in regard the 'Salmond within that River does never begin to Spawne till after 'the twenteith day of October, and that the only proper time for 'Salmond fishing within the said Water of Nith is from the first 'of March to the first day of November, Doe therefore, with advice 'and consent of the Estates of Parliament, hereby Statute and 'Ordain, that in all time coming the Salmond fishing within the 'said Water of Nith shall begin upon the first day of March, and 'continue to the first day of November yearly; and prohibits and 'discharges all slaying of Salmond within the said Water of Nith 'from the first day of November to the first of March, under the 'pains contained in the former Acts of Parliament made anent 'slaying of Salmond in forbidden times.' A proprietor in the Nith District, who is well acquainted with the River, writes me as follows on the subject of its lateness :—'Under the Act 'for the Nith, 1792, the open time was from 1st March to 5th 'October. Under the Solway Act of 1804, the open time for the 'Nith was from 10th March to 25th September. Under these 'Acts it was always considered the river opened *nearly* 2 *months* '*too soon*, and that it should have been left open till 5th October. 'From 1st May to 1st October is, beyond question, the proper 'fishing season for the Nith.'* At present, the close time for the Nith is from 10th September to 24th February, with extension of time for rod fishing to 31st October. The rivers that run into the Scotch shore of the Solway Firth are nearly all late rivers. In some of them, such as the Nith, Fleet, and Luce, the first clean fish do not appear until May or June, and I venture to think, as regards these rivers, and many others that may be mentioned on the west coast of Scotland, that it would be advisable, in any future legislation, to alter that part of the 9th section of 'The Salmon 'Fisheries (Scotland) Act, 1868,' which gives the Secretary of State power to vary the annual close time on the petition of a District Board, but subject to the proviso 'that such annual close time shall 'always be 168 days.' The words 'always be' should be altered into the words 'be not less than,' as suggested in my first Report to

* The most recent proof of the lateness of the Nith is afforded by the fact that on 8th December last, a considerable portion of the lower waters was netted in order to obtain a supply of salmon ova for Mr Armistead, who has a salmon hatchery in the Nith District. But only one female fish ready for spawning was got; and as none of the males were in the same condition, she was returned to the river. All the other fish got were clean and fresh run.

the Board, page 137. It would then be competent to District Boards, in the case of a river such as the Nith, where a longer close time than 168 days would be clearly desirable, to petition for such longer close time, instead of being tied up, as at present, to the hard and fast period of 168 days.

The Urr.

The river Urr rises in Urr Loch, on the borders of Dumfriesshire. It has a course of 25 miles and a drainage area of 117 square miles. It joins the Solway Firth about ten miles to the eastward of the town of Kirkcudbright, between the mouths of the Nith and the Dee. Its estuary at its junction with the Solway is nearly two miles wide, but is almost dry at low water. The tide flows seven miles up the channel of the river towards the town of Dalbeattie. There are a number of mills and manufactories on the banks of the Urr and on the Dalbeattie burn, which runs into it, and which supplies valuable water power. The dams connected with these works, having no passes, obstruct the ascent of salmon, while the lades in dry weather abstract the greater proportion of the water from the river. The Urr is decidedly a late river. Last autumn a District Board was constituted for the Urr; and since then the Board have petitioned the Secretary of State for an alteration in the annual close time, making it later in its commencement and termination than the present close time, which is from 10th September to 24th February, with extension of time for rod-fishing to 31st October; whereas the close time petitioned for by the Board was from 25th September to 1st March for nets, and 30th November to 1st March for rods.

The Dee.

The Dee is naturally one of the most productive and important rivers that flow into the Scotch side of the Solway Firth. It has a drainage area of 359 square miles; forms an estuary shortly before reaching Kirkcudbright; and joins the Solway six miles below that town. It issues from Loch Dee, which is situated in a wild romantic mountain region, remote and difficult of access. The trout in this loch are of large size and fine quality. One of 12 lbs. was killed by Mr Snowdon Henry from Kirouchtree; and on one day in July 1870 two rods captured with the fly 37 trout weighing 34 lbs. The best fishing months are April, May, and June. After leaving this Loch, the Dee receives the waters of Cooran Lane, a considerable stream springing from the Kells range of mountains, not far from the borders of Ayrshire and the head waters of the Doon. The Ken, which rises between Lorg and Blacklorg hills, 1870 feet above the sea, is a larger stream than the Dee, and has a course of 28 miles before its confluence with the Dee opposite Parton Station. Below New Galloway, it expands into a lake called Loch Ken, five miles in length, which abounds with pike. The largest pike ever caught in Scotland was

captured, last century, in Loch Ken with rod and fly by George Murray, gamekeeper to Viscount Kenmure. It weighed 72 lbs. and the head may still be seen in Kenmure Castle.

Yairs.

Yairs are fixed engines for catching salmon peculiar to the Dee. They belong to the Earl of Selkirk and the town of Kirkcudbright. It will be seen, on referring to the State of the Special Commissioners (Appendix No. I.) that Lord Selkirk is entitled to use four of these yairs, and the town of Kirkcudbright three, the Solway Commissioners having granted certificates of privilege for that number, and having, at the same time, ordered two yairs belonging to Lord Selkirk and one yair belonging to the town of Kirkcudbright to be abated or removed. These yairs are wicker-work erections, shaped like the letter V. A man sits at the point of the V with a net of a peculiar construction, and whenever a fish strikes the net is hauled up. The opening at the point of the V is about twenty feet wide. One set of yairs is used to fish with the ebb and another with the flood tide. Of course, these instruments are quite contrary to the general rule which everywhere prevails in Scotland, except in the 'water of Solway,' namely, that fixed engines for the capture of salmon within a river or estuary are illegal.

The Doachs at Tongueland.

The Doachs at Tongueland, and the Shoulder-net used for scooping out salmon from the deep pools below them, are another peculiarity of the river Dee. These Doachs are situated on the river, about three miles above the town of Kirkcudbright, and are loudly complained of by the upper proprietors as capturing or intercepting the great majority of the fish that have escaped the sweep-nets and the yairs in the lower part of the river, and are on their way to the upper waters. The owner of the Doachs, however, entirely denies that there is any foundation for this complaint. The Doachs are the property of Mr Murray Stewart of Broughton, who claims to hold them by ancient and special titles, and to be exempt from the operation of the bye-law regulating the construction and use of cruives and of mill-dams. These Doachs are partly natural and partly artificial, consisting of a formidable barrier of rocks which here stretches nearly across the bed of the river; which has been rendered more complete by artificial means; which now forms practically a cruive dyke, giving the owner or occupier the means of capturing and intercepting the great majority of passing fish; and which likewise acts as a dam to supply water to Tongueland Mills. There are three natural openings in these rocks, termed the 'Little Doach,' the 'Priory Doach,' and the 'Big Doach.' The 'Big Doach' is the passage which is used as a trap, and in it is fixed an ordinary cruive-box. The 'Priory Doach' is not used as a trap, and the 'Little Doach' has been left open for many years, except in so far as it has been deemed necessary to close and fish it for the purpose of maintaining all the owner's rights therein;

but from its height above the pool below it, it does not afford a free passage to ascending fish. And, if it be the case that the Tongueland Doachs are really cruives—which in my humble opinion they are,—there cannot be the slightest doubt that they are worked quite contrary to the provisions of the bye-law (Schedule F) which regulates 'the construction and use of cruives,' especially violating the first section of the said bye-law, which provides that, 'The upper surface of the sill of each cruive shall be not higher than '12 inches above the natural bed of the river where the cruive is 'placed, and in the event of the sill being placed any higher than 'the natural bed of the river, there must be a paved floor or apron to 'it down stream at least as wide as the cruive, having its lower end 'not higher than the natural level of the river, and having a slope 'not steeper than 1 in 6; and otherwise the cruives shall be so con-'structed as to afford a ready and easy passage for the fish during the 'annual and weekly close times.' With reference to the above, I may mention that at the time I inspected the 'Big Doach' and the deep pool called the 'Black Pot' below it, the sill or bottom of the Doach was at least 4 feet 6 inches above the level of the pool, and there was no paved floor or apron of any kind as prescribed in the bye-law. I may further mention that Mr Stewart, in his well-known Treatise on the law of Scotland relating to Rights of Fishing, states that fishing by means of Doachs is subject to the provisions of the above-quoted bye-law. 'A method of fishing, he says, 'not exactly the same as, but similar to, cruive fishing, was 'subjected by the Court to the regulations which affect cruives.' The case he alludes to is that of Peter Johnston and others, trustees of James Murray, Esq. of Broughton, against the Messrs Stott of Kelton and their commissioners, decided in the House of Lords 18th February 1802. In this case, an action was originally raised by the Messrs Stott, who were the proprietors of lands and salmon fishings about a couple of miles above the Doachs, to have it found and declared that these Doachs were really cruives, and must be constructed and worked subject to the rules and restrictions regulating that mode of fishing. It was found proved that the fishings at Tongueland had been carried on as far back at least as the middle of the seventeenth century by means of Doachs, as shown by an old valuation of 1642 and other documents. The Lord Ordinary found that 'cruives or doachs must be regulated in terms 'of the laws regarding cruive fishings, and that the blind eyes and 'other artificial obstructions or barricades to intercept the run 'of the fish in the river, within the bounds of the defenders' 'fishings, must be removed as illegal.' On reclaiming, the Court adhered, and found that the barricades termed 'blind 'eyes' must be removed from the spaces between the rocks, and the said spaces filled up with proper materials, formed and constructed like other cruive dykes. These 'blind eyes' were more effectual to intercept fish than a cruive dyke, because they admitted a passage to the water downwards, without allowing the salmon to proceed upwards; whereas, during a flood, when water was coming over the cruive dyke, the fish were able to ascend. The case was then appealed to the House of Lords, who ultimately

found 'that the form and construction of the cruive dykes and ' boxes, and the construction and position of the inscales, are to be ' regulated according to law,' and remitted back to the Court of Session to give precise directions to the parties about the form and construction of the cruive dykes and boxes, and the construction of the inscales according to law. I venture to think that it must be held that this case is decisive, and determines the point that these Doachs are really cruives, and that they must, consequently, be subject to the provisions of the bye-law which now regulates the construction and use of cruives, just as all the other cruives in Scotland, such as those on the Forth, Earn, Deveron, Conon, &c.—all of which are held under very ancient titles—admittedly are. It is understood, however, that it is maintained by the proprietor of the Doachs at Tongueland, that he is not bound to comply with the provisions of the said bye-law, because the 6th section of the Salmon Fisheries (Scotland) Act, 1862, which empowers the Commissioners under the Act to make general regulations with regard to the construction and use of cruives and other matters specified, has the following proviso attached to it:—'Pro- ' vided that such regulations shall not interfere with any rights ' held at the time of the passing of the Act under royal grant or ' charter, or possessed from time immemorial.' He holds that the terms of this proviso exempt him from the necessity of complying with the bye-law regulating cruives; and he is also understood to hold that the 9th section of the Salmon Fisheries (Scotland) Act, 1868, does not apply to the Doachs, because it has the same proviso attached to it as is attached to the 6th section of the Salmon Fisheries Act of 1862. The 9th section of the Act of 1868 empowers the Secretary of State to do certain things on the petition of any District Board, among others—'To alter the regula- ' tions with respect to the construction and use of cruives and cruive ' dykes or weirs within such district, provided such alterations do ' not injure the supply of water to any person entitled to use any ' existing cruive dyke as a dam dyke.'

There can be little doubt that it is somewhat difficult to tell what is the exact effect of the proviso at the end of the 6th section of the Act of 1862 and the 9th section of the Act of 1868 upon the bye-laws made by the Commissioners under the former Act; and Mr Buckland and I felt this so strongly, that one of the recommendations made at the end of our Report of 1871 on the effect of recent legislation on the Salmon Fisheries in Scotland is as follows:—'It should be more clearly ascertained and defined ' how far the 6th clause of the 6th section of the "Salmon Fisheries ' "(Scotland) Act, 1862," affects the bye-laws of the Commissioners.' At the same time, if the construction put upon the proviso by the owner of the Doachs were to be admitted, it would almost entirely strike at the root of the Commissioners' power to make any effective regulations whatever. Every bye-law that they have drawn up does, to some extent, interfere with existing rights, and some of them with ancient rights held by royal charter. Most valid rights of salmon fishings are of this kind, and if the Com-

missioners' bye-laws are not to affect them, they are in a great measure useless and unintelligible. The main purpose and object of the Act of 1862 is to interfere with and regulate existing rights of salmon fishings; and the principal bye-laws drawn up by the Commissioners, and approved by the Secretary of State, interfere with them in a very decided manner—such as those fixing an annual and weekly close time, determining estuary lines, regulating the mesh of nets, the use of dam dykes, and the placing of hecks on lades. The decision of the House of Lords in Johnston *v.* Stott, above referred to, appears to me to have definitely settled the point that the Tongueland Doachs are really cruives, and the case of Kennedy *v.* Murray, 8th July 1869, has fixed 'That the Salmon 'Fishery Commissioners, acting under the Act of 1862, have power 'to make bye-laws applicable to lades, dams, &c., whether in process 'of being constructed or repaired or not;' so that, taking these two cases together, it seems to me that we must arrive at the conclusion that the Doachs at Tongueland ought to be constructed and worked in terms of the bye-law (Schedule F) regulating the construction and use of cruives.*

A very peculiar kind of net, termed a 'Shoulder-net,' is used for taking out salmon from the numerous pools among the rocks at Tongueland, the most productive of which is a large deep hole immediately beneath the 'Little Doach,' termed the 'Black Pot.' The shoulder-net is a sort of gigantic landing-net. The handle or pole of the net is 24 feet long, and is made of Norway pine. The mouth is nearly semicircular in shape, being 7 feet 3 inches in length, while its breadth in the line of the pole is 5 feet. The net itself is 6 feet deep. This large net is used at night, and is thrown forward into the pools, which it searches thoroughly; and it is raised by placing the handle in a sort of wooden shoe, which is fastened upon the shoulder of the fisherman. It requires great strength and dexterity, as well as long practice, to become an adept in the use of the shoulder-net. But in experienced hands it is a most deadly weapon. The late John Richardson, who died a few years ago at the age of seventy, was the most accomplished and successful shoulder-net fisherman that ever lived, and he has been succeeded by his son, a strapping young fellow 6 feet high, who is said to be a promising fisherman. John Richardson kept a book in which he entered regularly all the fish he captured with the shoulder-net. Besides his regular wages, he got a penny for every salmon and a halfpenny for every grilse he took. In four of the best years his captures were as follows:—

* It should be stated that the owner of the Doachs denies that the decision of the House of Lords definitely settled that the Doachs were cruives, and maintains that the decision points in quite the opposite direction, in so far as it withdrew or deleted that part of the Interlocutor of the Court of Session which found that the Doachs or cruive dike and boxes, &c., were to be so formed, constructed, and fixed as to answer the purposes of a cruive fishery, and agreeable to the practice of these fishings in the north of Scotland where cruives have been regulated according to law; and the Lords further order that the case be remitted back to the Court of Session to give precise directions for the form, and construction, and position of the dike, boxes, inscales, &c. This was done, and the owner affirms that the Doachs have ever since been worked and regulated in conformity with the directions then given by the Court of Session.

	Salmon.	Grilse.
1838	546	7074
1840	1007	5415
1842	705	6482
1843	1042	4398*

It is alleged that the lade which supplies Tongueland Mills is not wrought in compliance with the terms of the bye-law (Schedule G), especially that part of it which provides that all water not required for the mills shall be made to flow over the dam as freely as possible; and it is asserted that 'the flour-mill lade at Tongueland runs 'full stream night and day, Sunday and Saturday.' On the other hand, it appears that in July last, the District Board made a careful examination, and found all the intakes properly hecked, and all the wheels, also all the tail-races, except the tail-race of the corn mill, and this the Board instructed the clerk to get fitted up in its former position, a little further down the lade.

When at Tongueland, I saw a number of grilse lying in the fish-house, and as the grilse in the Dee run large, I had three of the biggest taken up and weighed, and their united weight was 29½ lbs., or an average of nearly 10 lbs. each. In the second last week of July 1883, the average weight of the grilse caught at Tongueland was 8¼ lbs.

Sweep Nets on the Dee.

The lower part of the Dee is severely fished by net and coble. There are seven cobles, and the nets are long and deep, like those on the Tay, and are worked by means of a windlass fixed on shore. They take in the whole breadth of the river at each sweep, and overlap one another from the opposite sides, so as to prevent any fish from passing. It was stated to me by a gentleman well acquainted with the Dee fishings that the boat taking out the net is often allowed to hang on for five minutes. The oars are kept moving, in order to counteract the action of the flowing tide and keep the boat in its place, and when the boat is turned towards the bank, the rope, which is generally attached to the foot of the man in the boat, is let go at the proper time, by a movement of the foot. If this statement be correct, it is quite obvious that, while the boat remains stationary, the net forms a complete barrier to the passage of fish, and is used contrary to the rule laid down by Lord Westbury, in the case of Hay *v.* Magistrates of Perth, May 1863, namely, that 'the net must not quit the hand, and the net must be 'in motion during the operation of fishing.' This adds another to the many instances of over-fishing on our Scotch rivers by sweep-nets, and shows the necessity for some such limitation and restriction in the mode of working these nets as that suggested on pages 57 and 58 of my Report on the Salmon Rivers on the East Coast of Scotland. There is such a limitation in the English Salmon Fisheries Act of

* With reference to the above figures, taken from John Richardson's shoulder-net book, it should be mentioned that the proprietor of the Doachs denies their accuracy, and maintains that these fish were not all taken by Richardson alone, other persons having a share in the capture, and other kinds of nets being used as well as the shoulder-net.

1873, and in the Tweed Fisheries Act of 1857. The 62nd section of the Tweed Act provides that 'Every person who shall shoot or 'work any wear shot-net in the river within 30 yards of any other 'wear shot-net already shot, or being worked in the river, before 'such last-mentioned net is fully drawn and landed, shall for every 'such offence be liable in a penalty not exceeding £5.' I venture to suggest that, in any future legislation, this clause should be adopted, but instead of 30 yards it should be made 60. In the English Act it is 100 yards.

The Dilldawn Burn is one of the best spawning tributaries of the Dee; but, owing to a dam not far from its junction with the Dee, in connection with some irrigation works, several miles of valuable spawning ground are rendered almost entirely useless. This was pointed out by Mr Buckland and myself when we inspected the Dilldawn Burn in 1870. But no change for the better has since taken place. The dam in 1883 remains as great a barrier as it was in 1870. The Dilldawn runs into the Dee about six miles above Kirkcudbright. It is used for purposes of irrigation, and almost all the water in it is carried off by a sluice on the right side of the dam, which supplies water to about forty acres of grass land. In the centre, and across the course of the burn, is the dam over which the water passes into the natural bed of the stream. On the right of the dam is the sluice through which the irrigation water is passed; and on the left is a narrow off-flow or bye-wash, commencing some distance above the dam and entering the burn below it. This can be shut or opened by a sluice. The apron of the dam has a pretty gradual slope. But a log of wood with a perpendicular face runs along the crest of the dam, and in the log there is a cut about three feet wide, but going only half way down the face of the log. I recommend that this cut be carried right through the log down to the stone facing of the dam, and that a plank be provided capable of filling the cut, and fitting into grooves on each side, so that it may be taken out or put in as required. Or if it be objected to cutting right through the log down to the stonework of the dam, that the part of the log not cut through be bevelled off so as to be on the same slope as the apron of the dam. Immediately below the sluice through which the irrigation water is passed, there is at present a revolving cylinder of wire, with a wheel close below it,—the object being, by the combined action of these two, to prevent fish from being carried into the water-course which irrigates the meadows below. It seems to me that a much simpler plan would be to have a grating made of fine wire-netting, such as the smolt-proof hecks in use in England and Ireland, fitting into a wooden frame, and to fix this across the entrance into the irrigation water-course. This might be fitted into grooves in the masonry on either side, so as to be capable of being removed for the purpose of being cleaned from leaves and other débris brought down in floods. I understand that since my visit to the Dilldawn Burn in August last the manager for the owner of the irrigation works has expressed to the Clerk of the District Board his willingness to cut the beam on the crest of the dam down to the level of the stonework of the weir, to

clean out the bye-wash, and to repair the existing apparatus for preventing the passage of smolts into the irrigation lade. I hope, therefore, that the spawning capabilities of the Dilldawn Burn may yet be made available.

The present assessable value of the salmon fishings in the Dee district is £1200 a year, and the assessment levied on this by the District Board for the protection of the fisheries is £5 per cent.

I now proceed to describe the three rivers flowing into Wigtown Bay—the Fleet, the Cree, and the Bladenoch.

The Fleet.

This is a small river with a large estuary called Fleet Bay, which joins Wigtown Bay. It is formed by two branches—the big and the little water of Fleet—and has a drainage area of 36½ square miles. It is more of a sea-trout than of a salmon river, and is very late; the sea-trout first making their appearance in June, and the run of salmon being still later. Mr Murray Stewart is the proprietor of the fishings on the Fleet. When the Solway Commissioners were engaged in prosecuting their investigations into the fixed nets on the Solway under the Act of 1877, there were three fixed nets with six pockets used for the capture of salmon in the district of the Fleet, and one engine was claimed as privileged and a general claim made for others. The Commissioners, however, ordered three engines with six pockets situated near Carrick Point, Craigmore Point, and at a place between Aird's Bay and Tupstones, to be abated and removed; at the same time certifying one fixed engine with one pocket as privileged.

The Cree.

The Cree rises in Loch Moan on the confines of Ayrshire and Kirkcudbrightshire, runs south-east between the counties of Wigtown and Kirkcudbright, and falls into the head of Wigtown Bay. It has a rather long and wide estuary; a course of more than 20 miles from its source to the town of Newton-Stewart, near the head of the estuary; and a drainage area of 173 square miles. Its chief tributary is the Minnock, whose head-waters are not far from the source of the Stinchar in Ayrshire. The Minnock, as an angling and spawning stream, is far superior to the Cree; and at the point of junction it is the larger river of the two. There is a considerable lake called Loch Trool, which is one of the principal feeders of the Minnock. It is two miles long, about a quarter of a mile wide, and covers 320 acres. In some places it is from 70 to 80 feet deep. The outlet of the loch is through a narrow gorge, from 17 to 20 feet wide. When Mr Buckland and I visited Loch Trool in 1870, we approved of a plan for putting on a sluice near the outlet, so as to heighten the surface of the loch and to supply the means of letting down an artificial spate in dry weather when the river was too low to induce fish to run. We suggested that the artificial spate should be let down on the Saturday, so as to give fish wishing to ascend the benefit of the weekly close time, and that the sluice should be opened so that the spate should meet the flood tide. This has now

been carried out by Lord Galloway with satisfactory results. Sluices have been placed at the outlet of the loch, and are so regulated that an artificial supply of water sufficient for angling purposes can be sent down into the river when it would not otherwise be in fishing order. Anglers have thus been enabled to get fish in the river at times when, but for the artificial spate, not a single salmon would have risen to the fly.

Eleven stake nets, with fourteen pockets, in the Cree district were ordered to be removed by the Solway Commissioners under the Act of 1877. These nets were all within the estuary line for the Cree, Fleet, and Bladenoch fixed by the Scotch Commissioners under the Salmon Fisheries Act of 1862, which stretches across Wigtown Bay from Eggerness Point on the west through the centre of Barlocco Island, and thence to the nearest point of the mainland to the east of that island. There can be little doubt that the removal of these nets, which were placed far too close to the mouth of the Cree, will tend greatly to improve the angling not only in that river but also in the river Bladenoch.

Complaints were made in the Cree district that the sparling fishery, which forms a considerable industry in the estuary of the Cree and in Wigtown Bay, is so prosecuted as to injure the salmon fishings. The sparlings spawn in March and April at the head of the tideway among the small stones and shingle, but they never go farther up the river than the brackish water extends. They are very small in June and July, but are at their best in September. They are also in good condition and larger in November and December, but are not so plentiful. In these two months they will fetch 2s. per lb., and 8d. per lb. on an average throughout the year. The sparling net is three-quarters of an inch from knot to knot; and it is alleged that, when fishing in spring, these nets destroy a great many of the salmon smolts that are then on their way to the sea, and that, when fishing in autumn, they likewise capture a good many of the gravid salmon that are ascending to the fresh water for the purpose of spawning. It has been proposed, as a remedy, to have a close time for sparling fishing extending from 1st October to 15th March.

In the neighbourhood of Penningham House, a few miles above Newton-Stewart, there is a long stretch of dead water in the Cree very much infested with pike, which are also found in considerable numbers in the Penningham Burn, a tributary of the Cree. Their presence is, of course, highly injurious to the salmon fisheries, and some means should be adopted to keep them down.

During my inspection of the Cree district I visited the Linn of Glencaird, on the Minnock water, which, in certain states of the river, acts as a barrier to the passage of ascending fish. Their ascent might be greatly facilitated, without much expense, by judicious blasting on the left bank next the watchers' house. A round rock near the top of the fall and a jagged rock about the centre of the channel ought both to be removed. There are six miles of angling water above Glencaird Linn, with many good pools and streams; and below the Linn, and between it and the junction of the Minnock with the Cree—a distance of some three

miles—there are no fewer than twenty-seven fine angling pools. In fact, this part of the Minnock is a perfect model of what a small salmon river should be.

Bargrennan Linn, on the upper waters of the Cree, also requires attention. There are 12 miles of water above it, with much valuable spawning ground. But the access to this is at present very much interrupted by the height and steepness of the rocks at the linn. The rocks and pool on the left bank of the river offer great facilities for poachers, and would require constant watching. The pool is long, deep, and narrow, walled in on each side and at the head by perpendicular rocks from 12 to 15 feet high. A better place, in the latter part of the season, for 'snig-'gling,' or, as it is termed in England, 'strokehauling,' could not be imagined. When I inspected the pool in August last, it was full of fish, and I saw six or eight grilse trying to ascend the rock at the head, and, of course, falling back, baffled, into the pool. On the right bank of the river, however, an attempt has been made, with some degree of success, to blast a channel in the rocks, which have there a pretty gradual slope, so as to permit the ascent of fish. But near the bottom of the pass, the channel is too narrow, and should be widened; and the uppermost step should also be blasted, so as to give a resting-pool between it and the step immediately below. It might be advisable for the Cree District Board to consider whether it would not be desirable to place a permanent heck, similar to that used at the intake of mill-lades, at a narrow point below the deep linn on the left bank, which I pointed out to the watcher, so as to prevent salmon and grilse from going up to the foot of the inaccessible perpendicular rock at the head of the linn on the left bank, and turn them towards the channel on the right bank, by which they may be able to ascend to the upper waters in flooded states of the river.

The District Board of the Cree has been in existence for only three years. The following abstract of accounts will show the receipts, expenditure, and assessment during that period :—

ABSTRACT of ACCOUNTS of Cree District Board for three years ending Whitsunday 1883.

1881.	Expenditure,	–	–	£48	4	7	1881.	Receipts— Assessment on rental of £516, 10s., at 2s. 6d. per £, – – – –	£64	11 3
1882.	Do.	–	–	83	17	6	1882.	Assessment on rental of £522, 2s., at 2s. 6d. per £, – – £65 5 3		
								Voluntary contributions, – 22 10 0		
								Interest on bank account, 0 4 10		
									88	0 1
1883.	Do.	–	–	54	18	6	1883.	Assessment on rental of £532, 1s. 8d., at 1s. per £, £26 12 1		
								Voluntary contributions, – 10 0 0		
								Fines, – – 8 16 0		
								Interest on bank account, 0 4 10		
	Balance at Credit of Board,			11	3	8			45	12 11
				£198	4	3			£198	4 3

The Bladenoch.

The Bladenoch rises in Loch Maberry, not far from the Ayrshire march, and, after a course of 20 miles, falls into the west side of Wigtown Bay, near the burgh of Wigtown. Its principal tributary is the Tarff. Besides Loch Maberry, there are several lochs connected with the head-waters of both these rivers, which afford good trouting. There are four weirs on the Bladenoch, but none of them, except that at New Mills, act as obstructions to the passage of salmon. The dam at New Mills is by no means watertight, and though the river was in flood when I inspected it, scarcely any water was coming over the dam. It was soaking through it instead. Had the dam been faced with concrete so as to be watertight, a foot of water would have been coming over the crest, and fish would have been able to get up by the ladder in the centre, which would have been full. I could see no hecks at the intake or tail-lades of this mill or at those of any of the other mills on the Bladenoch. But as there is no District Board this is not to be wondered at; although, as has been already shown, the existence of a District Board does not always afford an absolute guarantee for the strict enforcement of the bye-law framed by the Commissioners under the Salmon Fisheries Act of 1862. There are two mill-dams on the Tarff, but they form no obstruction when the river is in such a state as to induce fish to run. The salmon on the Bladenoch are handsome fish, short, thick, and with small heads. It is a late river. It is not a good trouting stream, and, like the Cree, is much infested with pike. The first spring fish run about the end of April; and the grilse begin to run about the 10th of June. It occasionally affords good angling; and one proprietor in the district told me that, fishing constantly, he had killed 78 salmon in his best year, the heaviest 18 lbs.

The Luce.

For its size, the Luce is one of the best rivers both for sea-trout and salmon on the Solway. There are no fixed nets nearer its mouth than 650 yards on the one side and 1300 yards on the other, and no pollutions or obstructions, except a waterfall about 13 miles up the river. It is strictly reserved for angling. The sea-trout are numerous and large, fish of 3 lbs. and 4 lbs. being not uncommon. It is a very late river, few clean salmon making their appearance until the month of July. Very large salmon for so small a river—30 lbs. and upwards—are occasionally captured in the Luce. It falls into Luce Bay, a broad and deep inlet of the Irish Sea, which divides that part of the south-west coast of Scotland into two peninsulas, terminating in the Mull of Galloway on the west and Barrow Head on the east. The Luce is composed of two branches which unite at New Luce, about 7 miles from the sea. It has a course of nearly 20 miles, and a drainage area of 73 square miles. There is no District Board.

With regard to the decisions of the Special Commissioners acting under the 'Solway Salmon Fisheries Commissioners (Scotland) Act,

'1877,' respecting the fixed engines in the Solway, a reference to the State, giving the result of their proceedings, which forms Appendix I. to this Report, will show that, in Dumfriesshire, they have ordered the removal of 4 stake, fly, or bag nets, with 17 pockets, and have granted certificates of privilege to 34 with 126 pockets; that in Kirkcudbrightshire they have ordered the removal of 28 stake, fly, or bag nets, with 40 pockets, and have granted certificates of privilege to 31 with 62 pockets; and that, in Wigtownshire, they have ordered the removal of 44 such nets, and have granted certificates of privilege to only 15. That is to say, in Dumfriesshire they have ordered about an eighth of the fixed nets to be abated or removed, and have granted certificates of privilege to the remaining seven-eighths. In Kirkcudbrightshire they have directed nearly a half to be removed, and have granted certificates of privilege to rather more than a half. While, in Wigtownshire, they have ordered no less than three-fourths of the stake, fly, or bag nets to be removed, and have granted certificates of privilege to only a fourth. Or, taking the whole three Scotch counties that are washed by the waters of the Solway Firth, it will be found that the Commissioners have ordered 76 stake, fly, or bag nets to be removed, and have granted certificates of privilege to 80.

Annual Close Time for Solway Rivers.

In the note of points suggested by Mr Buckland and myself in 1870 for the consideration of the Annan Fishery Board, and answers thereto by the Board, which is printed on pages 89 and 90 of the Appendix to our Report of 1871, the Annan Board give the following answer to the question whether there should be the same annual close time for all the rivers on the Scotch side of the Solway:—'There should be one close time for all the Solway rivers. 'While one of them is closed and another open, fish taken in the 'former can be sold as having been taken in the latter.' I am inclined to agree entirely with this suggestion of the Annan District Board. At present, the annual close time for the Annan, Nith, Urr, Fleet, and Luce is from 10th September to 24th February, with extension of time for rod-fishing to 31st October; while that of the Dee, Cree, and Bladenoch is from 27th August to 10th February, with extension of time for rod-fishing to 31st October. I venture to think that it would be an advantage to the salmon fishing on the Scotch shore of the Solway generally if the annual close time of the Dee, Cree, and Bladenoch were assimilated to that of the Annan, Nith, Urr, Fleet, and Luce.

II. THE SOLWAY QUESTION.

The discovery of a fair and adequate solution of the Solway question is one of the most important, as well as one of the most difficult and complicated, problems to be dealt with in connection with Salmon Fishery law and legislation. The various legislative attempts that have been made to set the question at rest, and to reconcile conflicting interests, have hitherto failed; and it seems not unlikely to prove the chief difficulty and the principal source of debate in any future enactment.

It is no light or easy task to assimilate the law on the opposite shores of the Firth; there are so many hostile interests to reconcile, so many statutes, or parts of statutes, to alter or repeal; and so many rights, consecrated by long usage, and sanctioned by judicial decisions, that cannot be rashly interfered with. The proprietors on the English side of the Firth, where fixed engines have been abolished, not unnaturally complain of the stake-nets on the Scottish shore being allowed to remain and intercept the fish on their way to the English rivers; while the proprietors on the Scottish shore plead the long statutory exemption enjoyed by the 'Water of Solway' from the prohibition against fixed engines; the impossibility of successfully prosecuting their fishing except by means of such engines; the steady supply to the market in the south of Scotland and north of England of a nutritious article of food which these nets afford; the long period during which they have been used under sufficient titles; and the consequent injustice of abolishing them without making adequate compensation.

I shall now proceed to inquire more particularly into the details of this complicated and troublesome question, with the view of ascertaining whether any fair and satisfactory conclusions can be arrived at.

The precise meaning and extent of the term 'Water of Solway' is somewhat indefinite and difficult to ascertain. The old Scotch statutes make use of it, but do not define it. Thus the Act 1563, c. 68, 'Anent cruives and zaires,' which provides that all 'cruives and zaires that are set of late upon sands and schauldes 'far within the water, quhair they were not of before, that 'they be incontinent tane down and put away,' concludes with the following exemption:—'Providing always that this 'Act on naways be extended to the cruives and zaires being 'upon the Water of Solway;' but there is no definition of what is held to be the 'Water of Solway,' to which this prohibition against the use of fixed engines is not to extend. The statutory limits of the Solway Firth have also greatly varied. The 28th section of the Solway Act (44 George III. c. 45), which embraced both sides of the Firth, provides that 'Whereas disputes may arise 'touching the limits of the said arm of the sea: Be it therefore 'further enacted, that for the sole purpose of executing this Act, 'and no other, the same shall extend over and across the whole of 'the said arm of the sea which lies eastward from a place called 'the Hotel at Skinberness, in the parish of Abbey Holme, in the 'county of Cumberland, and from thence in a direct line across the 'said arm of the sea, extending northward to the large house at 'Carsethorn of Arbigland in the stewartry of Kirkcudbright, and 'from thence westward along the shore of the said arm of the 'sea which adjoins the county of Dumfries, the stewartry of Kirk-'cudbright, and the county of Wigtown aforesaid, for two miles in 'breadth, pointing southward from high-water mark down to a 'place called the Mull of Galloway, in the said county of Wigtown, 'and also in like manner extending westward along the shore of 'the said arm of the sea which adjoins the said county of Cumber-'land, from the Hotel of Skinberness aforesaid for two miles in

'breadth, pointing northward from high-water mark down to a 'place called Hodbarrow Point, in the parish of Millam, in the said 'county of Cumberland; and likewise, for the sole purposes of this 'Act, and no other, the limits of the mouth or entrance of the river 'Nith, situate in the county of Dumfries aforesaid, shall for the 'future be deemed and taken to be and extend from the large house 'at Carsethorn of Arbigland aforesaid, in a line across the said river 'Nith due east.' Lastly, 'The Salmon Fisheries (Scotland) Act, '1862,' empowered the Commissioners (sect. 6, clause 2) 'to fix 'for the purposes of this Act the limits of the Solway Firth, having 'regard to an Act passed in the 44th year of the reign of His 'Majesty King George the Third, chapter 45;' and the Commissioners, by their bye-law, which took effect from 9th April 1864, fixed the limit dividing the Solway Firth from the sea 'to be a 'straight line drawn from the Mull of Galloway in the county of 'Wigtown, to Hodbarrow Point in the parish of Millam in the county 'of Cumberland.'* Within the estuary line thus defined, the Commissioners fixed a number of other estuary lines, such as those of the Luce, the Cree, Fleet, and Bladenoch, the Dee, the Urr, and the Nith, Annan, and Esk. In the case of Johnston *v.* Mackenzie and Others, already referred to, the estuary line fixed by the Commissioners for the three last-named rivers has been found quite ineffectual to exclude fixed engines, and indeed the object of fixing such lines within the 'Water of Solway' seems somewhat difficult to discover. In other parts of Scotland their purpose is obvious. They effect what was formerly only determined by a jury trial—the marking out of the boundary within which fixed engines are illegal under the old statutes. But the estuary lines of rivers flowing into the 'Water of Solway' cannot have this effect, as these waters are exempted from the prohibition against fixed engines. Of course, if fixed engines, at or near the mouth of any of these rivers where the tide ebbs and flows, can be shown not to be within the 'Water of the Solway,' the exemption of the old statutes cannot protect them, and they may be put down. But whether they are or are not in such a situation is a question for the Court to determine, and the estuary lines of the Commissioners appear to be of little use for this purpose.

In Scotland, generally, at this moment, it is only the operation of the old Scottish statutes, and the decisions following upon them, that make the use of fixed engines in estuaries illegal. But these old statutes did not apply to the Solway Firth. It was specially exempted, and for the very evident reason that, at the time when they were framed, England and Scotland were frequently at war, and it was of no use enforcing on the Scottish side restrictions which could not also be enforced on the English, and which, even on the Scottish side, might at any time be broken through by English invaders. It may be said that times have changed, that the two countries have been long at peace, and that there is now no reason for making the estuaries of the Solway rivers an exception to the rules enforced in the other estuaries in Scotland. This

* With regard to the bye-law fixing this limit, see 'Explanatory Note' by Mr Leslie, C.E., one of the Commissioners, Appendix No. V.

may be perfectly true, and it may be expedient to abolish fixed engines in these estuaries. But the owners of these engines, who hold a good title, have for centuries had a right to use fixed engines in these localities ; and if they are to be deprived of that right, they ought to be compensated for the deprivation.

The 3d section of 'The Salmon Fisheries (Scotland) Act, 1862,' provides that 'From and after the 1st day of *January* 1865 the 'provisions of the said Act, entituled "*An Act to Amend the Laws* 'relating to Fisheries of Salmon in England," shall extend and apply 'salmon fisheries in the waters and on the shores of the *Solway* '*Firth*, situate in *Scotland*, as the same may be fixed by authority 'of this Act, and to the rivers flowing into the same, in so far as 'such provisions relate to the use of fixed engines for the taking 'of salmon ; provided that all offences against such provisions shall 'be prosecuted and punished as directed by this Act.' The 11th section of the English Act of 1861, here referred to, abolishes fixed engines 'in any inland or tidal waters ;' but it also provides that 'this section shall not affect any ancient right or mode of fishing, 'as lawfully exercised at the time of the passing of this Act, by any 'person, by virtue of any grant, or charter, or immemorial usage.'

With regard to the exception in the foregoing clause in favour 'of any ancient right or mode of fishing, as lawfully exercised at 'the time of the passing of the Act, by virtue of any grant or 'charter or immemorial usage,' the English Salmon Fishery Act of 1865 contains the following provision (section 39) :—'Be it enacted 'that the said provisions shall extend to exempt from the said 11th 'section such fixed engines only as were in use for catching salmon 'during the open season of 1861, in pursuance of an ancient right 'or mode of fishing as lawfully exercised during such open season, 'by virtue of any grant, or charter, or immemorial usage, which 'last-mentioned fixed engines are hereinafter referred to as privileged 'engines. But, inasmuch as in certain cases fixed engines in use 'during the four years previous to 1861, or one of such years, may 'from temporary causes have been out of use during the year 1861, 'and it is expedient to provide for such cases, it is hereby declared, 'that if it is proved to the satisfaction of the Special Commissioners 'appointed under this Act, that any fixed engine not in use during 'the open season of 1861, was in use during one of the said four 'years, proof of its user during one of such four years may be sub-'stituted for proof of its user during the open season of 1861; so, 'nevertheless, that no person shall by proving the use of different 'fixed engines during the said years be allowed to be entitled to a 'number of privileged engines exceeding the greatest number of 'such engines in use by him during some one of the years 1857, '1858, 1859, 1860, 1861.' It would consequently seem that all fixed engines are illegal, on the Scotch as well as on the English side of the Solway Firth, unless lawfully used at the time of the passing of the Act of 1861 (or one of the four preceding years) by virtue of any grant, or charter, or immemorial usage. The English Special Commissioners, who were empowered by the Act of 1865 to adjudicate on the legality of fixed engines, decided in April 1867 that their powers did not comprehend the

fixed engines on the Scotch shore of the Solway, and soon afterwards the Home Secretary announced in Parliament that the law officers of the Crown concurred in this decision, and that these engines could not be dealt with without further legislation.

An express grant of fixed engines in those parts of the 'Water of 'Solway' where the sea ebbs and flows will confer a valid title; but an express grant of fixed engines where the tide ebbs and flows, but which cannot be shown to be within the 'Water of Solway,' will not be sufficient, because such a position is not exempted from the prohibitions of the old statutes. In other parts of Scotland, a grant of fixed engines within an estuary is ineffectual, but in the Solway, where such engines in such a situation were not illegal previously to 1862, an express grant prior to that date will confer a right which cannot be defeated by the subsequent prohibitions. Thus in the case of Johnston *v.* Mackenzie and Others, 20th July 1869, it was found that the Solway Firth was exempt from the restrictions of the old statutes, which made fishing for salmon by stake-nets in the estuary of a river illegal, and that the Newbie fishings, far within the Commissioners' estuary line for the Esk, Annan, and Nith, were legally exercised by means of such nets. From the evidence of Thomas M'Queen—a very old tacksman of salmon fishings—given in that case, it appears that these Newbie fishings were fished by the Littles—the then tenants—with stake-nets so far back as 1778, and that previously to that date they had been fished by means of fixed engines, with this difference, that there was wattling instead of netting between the stakes.

It is a mistake to suppose or assert that the fixed nets on the English side, abolished by the Act of 1861, were in the same position as the fixed nets which still exist on the Scottish side. On the English side, the right to fish by such nets in a navigable arm of the sea was not a private right, except in very rare and exceptional instances, but a right common to the public, or what is termed a right of common fishery. There was, therefore, in the general case, no interference with vested rights or private property in abolishing these nets. On the other hand, all those proprietors on the Scottish shore who have a good title to fish by means of fixed engines in the 'Water of Solway,' possess that right as private real property in the strictest and fullest sense of the term, derived from the Crown, in whom all the salmon fishings in Scotland, in rivers, estuaries, and in the narrow seas were originally vested as part of the *patrimonium principis.* These fishings have again and again been the subject of Acts of Parliament and of decisions of the Supreme Court, all confirming their legality. It may or it may not be expedient to abolish them. But if their abolition be decided on, it seems obvious that it could not be carried through without injustice, unless compensation were granted to their owners. Such engines are, in fact, very much in the position of the privileged fixed engines mentioned in section 41 of the English Salmon Fishery Act of 1865.

In 1871, in my Report on the Solway question, I made the following suggestions for bringing about a satisfactory solution of it:—'1. The appointment of a Commission for the purpose

'of ascertaining the validity of the titles held by all owners of 'fixed nets on the Scottish shore of the Solway Firth. 2. The 'abolition of all the fixed nets whose owners cannot produce a suf- 'ficient title—of course with the consent of the Crown, in whom 'the right to the fishing would vest on no title being produced by 'a private party. 3. The valuing of all the fixed nets with a suffi- 'cient title within the estuary lines of the various rivers flowing 'into the Solway Firth, as fixed by the Commissioners under "The 'Salmon Fisheries (Scotland) Act, 1862," say at twelve years' 'purchase of their average rental for the previous five years, and 'the empowering of the adjacent river proprietors to buy them up 'at that rate for the purpose of removal; or making compensation 'to their owners in some other way, if the removal of these nets 'shall be deemed desirable. 4. The numbering and registering of 'the fixed nets to which a good title can be produced, situated on 'the shores of the Firth, between the extremities of the estuary lines 'of the rivers falling thereinto, and the prohibition of any addi- 'tional fixed nets in such a situation.'

The 1st, 2nd, and 4th of these suggestions have since been in a great measure carried out by the appointment of Special Commissioners, under the 'Solway Salmon Fisheries Commissioners Act, '1877,' who, subject to an appeal to the Court of Session, inquired 'into the legality of all fixed engines erected or used for the 'taking of salmon in the waters and on the shores of the Solway 'Firth in Scotland, as the same have been fixed under the autho- 'rity of "The Salmon Fisheries (Scotland) Act, 1862," and in the 'rivers flowing into the same.' These Commissioners made a prolonged and careful inquiry into the subject of the fixed nets in the Solway, removed a number of them, and granted certificates of privilege to a still greater number. The result of their labours will be found in the Appendix to the present Report, Nos. I. and II.

The last step taken towards a settlement of the Solway question was in 1880, when Mr Spencer Walpole and myself were appointed by the Secretary of State Commissioners to inquire into the laws affecting the salmon fisheries on both sides of the Solway Firth, with the view of placing them under uniform legislation. In the course of that inquiry, we visited the rivers on both sides of the Firth, and carefully inspected the various kinds of nets used for the taking of salmon on the Scotch side. We also examined witnesses at Carlisle, Port Carlisle, Boness, Langholm, Annan, Dumfries, Kirkcudbright, and Newton-Stewart; and, in 1881, we published our Report. At its close, we give a summary of the conclusions at which we have arrived. They are as follows:—

'I. The Acts relating to the Solway, *i.e.*, the Solway Act, 44 'Geo. III. c. 45, and the Annan Act, 4 Vict. c. 18, should be 'repealed.

'II. The limits of the Solway for salmon fishery purposes should 'include all that arm of the sea which is situated between Scotland 'and England, and which lies east of a line drawn from the large 'house at Carsethorn in Arbigland in the stewartry of Kirkcud- 'bright, to the hotel at Skinberness in the parish of Abbey Holme 'in the county of Cumberland, and west of a line drawn from the

'west bank of the Water of Sark, at Sark Foot, in the county of 'Dumfries, to Burgh Head in the county of Cumberland.* Within 'the aforesaid limits the Solway Firth should include the sea and 'the rivers so far as the tide flows and ebbs.

'Outside these limits—

'(*a*) All the rivers which are entirely Scotch should be placed 'under the Scotch laws.

'(*b*) All the rivers which are entirely English should be 'placed under the English laws.

'(*c*) The Esk, which is partly Scotch and partly English, 'should continue under the English law, adminis- 'tered by Scotch Courts as regards the portion of 'the Esk in Scotland, and the Scotch Acts so far as 'it is concerned should be expressly repealed.

'IV. Inside these limits—

'(*a*) The annual close season should commence on the 10th 'of September, and continue till the 15th of March, 'both inclusive.†

'(*b*) The weekly close season should commence at the low 'water next after 6 A.M. on Saturday, and continue 'for four complete tides.

'(*c*) The mesh for taking salmon should be not less than $1\frac{3}{4}$ 'inches from knot to knot, or 7 inches round.

'The above recommendations are all intended to assimilate the 'law. In addition to them we recommend that—

'V. The licence duty for a whammel net should in future be £5 'for the first 400 yards or part of 400 yards, and £1 additional for 'every additional 80 yards or part of 80 yards.

'VI. The Lords of the Admiralty should be requested to buoy out 'the boundary between Scotland and England from Sark Foot to 'the centre of the line drawn from Carsethorn of Arbigland to 'the Hotel of Skinberness, charging the cost of the work on the 'Nith, Annan, Esk, and Eden.‡

'VII. East of this line all Paidle nets should be declared illegal, 'or no Paidle net should be used which, if it had a coop or cover, 'exceeded 3 feet in height; or which, if it had no coop or cover, 'exceeded 4 feet in height; but compliance with this regulation 'should not make any Paidle net legal which would otherwise be 'illegal.

'VIII. The 25th section of the Scotch Salmon Fisheries Act, '1868, should be extended to the Scotch shores of the Solway.

* 'Power should be given to some competent persons to fix stakes or other marks 'on the foreshores of the Esk and the Eden to indicate these limits.'

† 'It is to be understood that these two recommendations stand and fall together. 'In the event of the weekly close season, for instance, being reduced from four to 'three tides, an alternative which the Legislature might possibly prefer, we recom- 'mend that the annual close season should commence on the 3rd of September and 'terminate on the 23rd of March. In the event of the weekly close season being 'reduced to two tides, we recommend that the annual close season should commence 'on the 27th of August and terminate on the 31st of March. Of the three alterna- 'tives, however, we prefer that in the text.'

‡ As without a map the proposed new limits of the Solway Firth would not be generally intelligible, a map is given in Appendix No. VI.

'IX. The Conservators of the Eden, the members of the Esk and 'Liddle Angling Association, the District Board of the Annan, and 'the District Board of the Nith, should respectively appoint a re-'presentative trustee.

'X. There should be annually paid to the trustees so appointed 'such portion of the revenues of the four rivers, not being more 'than one-fifth or less than one-tenth, as the trustees might deter-'mine; and the amounts so paid should be invested from time to 'time for the purpose of being ultimately applied to the purchase 'of the fixed engines on the Scotch side of the Firth, if a majority of 'the representative trustees should consider such purchase desirable.

'XI. The powers of the trustees should continue till the purchase 'of these engines was accomplished (should such purchase be 'deemed desirable), and until any debts which they might have 'incurred had been defrayed; and, subject to these conditions, they 'should have power to hold any fishery which they might acquire; 'and to borrow any money on the revenues which might be payable 'to them.*

'XII. No fixed engines other than those declared legal by the 'Special Commission under the Act of 1877 should be legal on the 'Scotch side of the Solway.

'XIII. In the event of any legislation on the subject of the 'English Salmon Fisheries, we recommend that opportunity would 'be taken to re-enact the clause of the Solway Act relating to the 'use of nets for trout and other fresh-water fish.

'XIV. In the event of any legislation on the subject of Scotch 'Salmon Fisheries, we recommend that a new clause prohibiting 'unqualified persons from fishing in private waters should be sub-'stituted for the 9th section of the Solway Act.

'XV. We wish to add that grave inconvenience arises from the 'fact that a summons issued in England is not serviceable in Scot-'land, and *vice versa*. This alteration of the law, however, is, we 'believe, required on general grounds, and ought not to be confined 'to salmon fishery purposes.'

III.—THE SALMON RIVERS OF AYRSHIRE.

Ayrshire has a coast-line of 70 miles on the Irish Sea and the Firth of Clyde, and has six considerable rivers—the Stinchar, the Girvan, the Doon, the Ayr, the Irvine, and the Garnock. The three last named are now almost salmonless owing to pollutions, obstructions, and poaching, and there is no District Board on any of them. But the fishings on the Stinchar, Girvan, and Doon, especially those on the Doon, have rather improved since the late

* It ought to be mentioned that the Annan District Board, within whose jurisdiction are the most valuable stake-nets on the Solway Firth, strongly object to the provisions of this and the immediately preceding section, on the ground that it is unjust and unfair, not only to suppress the most valuable net fishings in their district, but also, in addition, to make them pay for that suppression

Mr Buckland and I visited them in 1870. There is a District Board on the Girvan, and the salmon fishings in the Doon are regulated by the Associated Heritors of the River Doon, of which Association the Marquis of Ailsa is chairman. At intervals along the 70 miles of coast, there are considerably upwards of a hundred fly and bag nets. And these nets are allowed to be placed, and are placed and used, only 400 yards from the mouths of the Ayr, Doon, Irvine, and Garnock; only 350 yards from the mouth of the Stinchar; and only 300 from the mouth of the Girvan. And, what is still more objectionable, several fly and bag nets are allowed to fish between the mouths of the rivers Ayr and Doon, which fall into the sea less than two miles apart from each other; although the Commissioners, under the Salmon Fisheries Act of 1862, recommended an estuary line from Deil's Dyke to the south of the mouth of the Doon to Bell Rock to the north of the mouth of the Ayr, which, of course, would have effectually prevented any fishing by fixed nets between the mouths of these two rivers. Upon this subject Mr Buckland and I wrote as follows in Appendix No. XII. to our Report of 1871:—'We think that the present estuary line is a great mistake, 'being much too contracted. Two rivers like the Doon and Ayr, 'flowing into a bay of the sea so near each other, ought to have 'only one estuary, and no fixed nets should be allowed between 'their mouths.' My recent inspection of the estuaries of these two rivers has only served to confirm my conviction of the correctness of the views thus expressed thirteen years ago. I shall now proceed to report upon the Ayrshire Rivers, individually, beginning with the southmost.

The Stinchar.

The Stinchar is a beautiful mountain stream, rising in the upland moors of the parish of Barr, and falling into the sea at Ballantrae, after a course of somewhat less than thirty miles. There are scarcely any pollutions; and though there are dams at Daljarroch and Pinclantie, they do not seriously obstruct the passage of fish when the water is in such a state as to induce them to run. Fixed nets, however, are permitted within 350 yards of the mouth of the river, whereas they ought to be removed to at least 700 yards. The sweep net, too, is used freely within the river itself; and this complete and systematic netting in so small a stream, effectually prevents anything like a fair proportion of salmon and grilse from reaching the upper waters until after the 10th of September, when the netting season closes. The sea nets capture the majority of the fish seeking the river, while those that escape the sea nets are taken by the sweep nets in the lowest mile of the river; and it is alleged by persons on the spot, who have known and observed the Stinchar for many years, that the effect of this constant use of the sweep net has been almost to annihilate sea-trout, and to render abortive any advantage that might otherwise have resulted from the institution of a weekly close time. From the dam at Daljarroch down to the sea, a distance of some eight

miles, the bottom of the Stinchar is formed of a succession of fine gravel beds admirably suited for spawning. But these are apt to shift with floods, and near the mouth of the river there is a gravel bar running parallel with the sea, extending from the harbour to the Downan Point, and forming a bank of considerable height, which, however, varies somewhat with the direction of the wind and the character of the weather. The Stinchar flows through this bank to the sea. In summer, when the river is very small, its outlet to the sea through the gravel bar entirely closes, and it continues in that condition until there is a flood of sufficient force to clear away the obstruction. Below the bridge at Ballantrae, the north bank of the river is not sufficiently substantial, and in floods the stream frequently breaks through and finds a new channel for itself to the sea through the gravel bar. It will thus be seen that the mouth of the river is continually changing. The natural place, however, for the Stinchar to empty itself into the sea would be at the Downan rocks, and this would be the only place where it would be possible to keep its mouth always open. This could be done by driving in piles on the north side of the river beyond the gravel seawards. The Stinchar is a very late river, the first fresh-run fish not appearing until May or June; and it is stated by Mr Wason, Postmaster at Ballantrae, who is an experienced angler, and thoroughly acquainted with the river, that the heaviest and finest fish do not come up until late in the autumn, and that they are in good condition until the middle of November. Were it not, unfortunately, the case that salmon caught during the extension of time for rod-fishing may be legally sold in open market in Scotland—though such sale is prohibited in England and on the Tweed—angling until the 15th November might be safely permitted on such rivers as the Stinchar and on several of the Solway rivers.

The Girvan.

The Girvan has its source in some small lochs in the parish of Straiton, about eight miles above the village of that name. It is nearly 30 miles in length, and has a catchment basin of 96 square miles. It falls into the sea 21 miles south-west of Ayr, nearly opposite the bold rocky island of Ailsa Craig, which is 10 miles distant. Its name is said to be derived from *Garv-avan*, or *Garvan*, signifying a rough or rapid stream, which is highly descriptive of the physical characteristics of the Girvan. Bag nets are permitted to fish, and do fish, within 300 yards of the mouth of the river; and there are upwards of forty such nets in the Girvan district, which has a coast-line of about sixteen miles. The leaders of the nets nearest to the river's mouth are 80 yards long. Since Mr Buckland and I inspected the river in 1870, the numerous dams that then obstructed its channel have been greatly improved, and the fish have now a better chance than formerly of reaching the upper spawning waters. The lowest mill-dam on the river is at Bridge Mill. It is 196 feet long, and has a gradient of 1 in 6. It used to be a very serious obstacle. But as the recom-

mendation made by Mr Buckland and myself, in our Report of 1871, that a subsidiary dam should be built below the main dam from one side of the river to the other, has now been carried out, salmon have no difficulty in ascending. The subsidiary dam is about 40 yards long, and cost £300. The lade connected with this mill in dry weather abstracts half the water from the river. There is an ingenious revolving heck at the tail-lade. The weir next above this is at Barons Mill. But, I was informed that this mill is likely to be given up and the weir done away with, as the buildings have been allowed to become ruinous, and are not to be repaired. The dam on the Girvan at the Kilkerran Sawmills is 4 feet 8 inches in height, with a gradient of 1 in 2½—a much steeper gradient than is permitted by the bye-law (Schedule G) which regulates the construction and alteration of mill dams, lades, &c. But when the river is high, fish have no great difficulty in ascending. The dam at the Kirkmichael Sawmills, which in 1870 was the worst obstacle on the river, has now ceased to be so, as floods have torn a gap in it 10 yards wide, quite down to the bed of the stream; and it was stated to me that this is not likely to be filled up. The natural obstruction above all these weirs, called the Linn of Blairquhan, retards the passage of salmon to many miles of excellent spawning ground, except when the river is in flood. When I inspected it last autumn, there was a great rush of water over the rock, as the river was just beginning to subside after a heavy flood. A ridge of rocks hollowed out beneath runs quite across the channel. The height of the jump from the linn below to the stream above was about 5 feet when I saw it. But when the river is low it may be a foot or two more. I observed several fish attempting to make the jump, but I saw only one succeed in surmounting the obstruction. All the others failed and fell back. It seemed to me that access to the upper waters would be facilitated by blasting out about the centre of the falls, 6 feet or so in width of the projecting ledge of rock, and making a V-shaped cut or channel, extending for some distance upwards from the crest of the rock left after the ledge had been blasted, or else—and if this could be done, it would be the surest and most effectual plan—to build a subsidiary dam across the narrowest part of the stream below the linn, say from 2 feet 6 inches to 3 feet in height. This would raise the water to that extent on the face of the falls, and would give ascending fish two perfectly easy jumps, with a pool between to rest in, instead of, as at present, one difficult jump. There might be a doubt of the subsidiary dam standing the winter floods, unless it was constructed of heavy blocks of concrete. Of ordinary stone there is abundance at hand. Such a dam, too, might possibly rather detract from the beauty of the linn and surrounding scenery. There are five miles of good angling water and excellent spawning ground above Blairquhan Linn. But I was informed that beyond this there is another fall, about 20 feet high, called Tairland Linn, which shuts out several miles of good breeding water. The rent of the sea fishings in the Girvan district is £415, and of the river fishings £160. The assessment for watching and protecting the river imposed by the District Board

was 2s. per £1 in 1880. There has been no assessment since that year. There is no regular water-bailiff specially employed by the Board. But the Board pays a gamekeeper £10 a year to watch the river.

The Girvan is not so good a spawning stream as the Stinchar. In the latter there are splendid beds near the sea, while in the former the best spawning beds are 12 or 14 miles distant from the sea, above the Linn of Blairquhan.

In 1870, a gentleman, who had a long and an intimate acquaintance with the fishings in the Girvan river and district, mentioned to Mr Buckland and myself that, eight years before, when, by agreement among the Girvan proprietors, the sea-nets had been removed to 500 yards distance from each side of the river's mouth, and when no netting was permitted in the river itself below Bridge Mill dam, there were ten times as many salmon as at the time he spoke, when these restrictions had, for some years, been given up.

The Doon.

The Doon rises in that wild Highland district which forms the northern portion of Galloway, a region of lofty mountains and numerous lochs, in which many of the rivers falling into the Solway Firth and the sea that washes the coast of Ayrshire have their sources. Its head-waters spring from Loch Enoch, a desolate, granite-bound loch 1650 feet above the sea, from which a considerable stream runs into the upper part of Loch Doon, a beautiful sheet of water 6 miles long, and covering nearly 1300 acres. From the foot of Loch Doon, the river rushes through a sluice cut in the rocks into Ness Glen, one of the most picturesque glens in Ayrshire, where there is only room for the river frothing and foaming along its narrow channel, and a footpath along the left bank. From thence, after a course of about a mile, it runs into the meadows below; passes not far from the flourishing town of Dalmellington, which owes its prosperity to the ironworks in the neighbourhood; flows through Bogton Loch, which is terribly infested with pike; and, after a farther course of about sixteen miles, falls into the sea within two miles of the mouth of the river Ayr. When I first inspected the Doon in 1870, it was in a very bad state, owing to pollutions and obstructions, and general neglect of the provisions of the Salmon Fishery Acts of 1862 and 1868; and I have now much pleasure in stating, that since then matters have greatly improved. Pollutions and obstructions have been much diminished, though there is still room for improvement; there are now hecks at the intake and tail-lades of all the mills on the Doon; and, thanks to the enlightened liberality of the Marquis of Ailsa, the number of fish in the river has been greatly increased by means of artificial stocking. Fly and bag nets are still allowed between the mouths of the Doon and Ayr. Seven flies and eight bags intercept the fish between the mouths of these two rivers, which are little more than two miles apart. In their admirable Report to the Associated Heritors of the

river Doon, dated 1855, Mr James Leslie, C.E., afterwards Commissioner of Scotch Salmon Fisheries, and Mr Shaw of Drumlanrig recommend, among other things for improving the Salmon Fisheries, that 'no stake nets, bag nets, or implements of any description for 'the catching of fish ought to be used within 2000 yards in a 'straight line from the nearest part of the fresh water stream of 'the river, as traceable along the sands at low water of spring tides, 'and as far as possible these modes of fishing ought to be given up 'altogether, or not continued longer than the 10th of August. 'This removal of all fixed obstructions to the entrance of the 'salmon into the river, ought to be one of the first things taken 'into consideration and adopted by the Associated Heritors of 'Doon, else all other appliances to facilitate the ascent, increase, 'and protection of the salmon in the river will be of little moment 'to the fishings generally.' The estuary line originally drawn up by the Commissioners of Scotch Salmon Fisheries, under the Salmon Fisheries Act of 1862, included the mouths of the Ayr and Doon, and consequently excluded all fixed nets from between their mouths. It extended from Deil's Rock, about 1600 yards to the south of the mouth of the Doon, to Bell Rock, about a mile and a third to the north of the mouth of the Ayr. A map of this estuary line, and also of the estuary lines ultimately fixed by the Secretary or State, on 16th April 1864, for the Doon and Ayr separately, will be found in Appendix No. XII. to the Report of 1871, by Mr Buckland and myself, on the effect of recent legislation on the Salmon Fisheries in Scotland.*

At the Dalrymple Bobbin Mill, some miles up the Doon, there is a turbine wheel, which would require a small-meshed wire heck or grating to prevent the smolts being swept into it, and killed at the time when they are descending to the sea. Below this mill, and between the tail-lade and the Doon, there is a great mound of sawdust, which forms for several yards the banks of the river. This is highly objectionable, as every flood must inevitably sweep away parts of this mound into the stream, to the great injury of the fish in the neighbourhood, whose gills it is apt to choke up, and so kill them by mechanical poisoning. A great heap of sawdust left in such a position is quite contrary to the 7th subsection of the 15th section of 'The Salmon Fisheries (Scotland) Act, 1868,' which provides that every person 'who wilfully puts or causes to be put, or 'neglects to take reasonable precautions to prevent the discharge 'of any sawdust, or any chaff, or any shelling of corn, into any river, 'shall for every offence be liable to a penalty not exceeding £5, and 'to a farther penalty not exceeding £2, for every salmon taken or 'killed in an illegal manner, and shall forfeit the salmon so taken.'

Before the end of last century, Loch Doon discharged its waters in flood over a steep rock into Ness Glen; and the floods

* It is but fair to state that some persons of great local experience strongly object to the removal of the fixed nets between the mouths of the Doon and Ayr. One lessee of salmon fishings writes me—'If such fishings were done away with, where 'would we look for a supply for our markets?' The answer to which appears to me to be, that there would be abundance of stake and bag nets left along the Ayrshire coasts to supply the market, even if those now fishing between the mouths of the Ayr and the Doon were removed.

used to raise the level of the loch to such an extent that the river, receiving the accumulated waters from this extensive reservoir, overflowed its banks, and damaged the productive lowlands below Ness Glen. With a view of putting a stop to this, the two chief proprietors of the loch, the Earl of Cassilis and Mr Macadam of Craigengillan, in the end of last century, cut tunnels through the rock at the exit of Loch Doon, and constructed sluices intended to regulate and control the outflow of the water. The experiment, however, was not successful. The land gained from the loch by lowering its level was of little value, and the other objects aimed at were not attained. There are two sluices at the top of Ness Glen, each 6 feet in width and 6 feet 8 inches in depth, raised by levers so situated that for weeks together they cannot be worked in time of flood. There should be a wooden staging so placed as to enable them to be worked at all times. The tunnels cut through the rock to the river below are 66 feet long. One of the sluices is kept open all the year round; the other is scarcely ever opened. The rush of water through the open passage is in general too violent to allow of the free ascent of salmon. In the first part of the valuable Report above alluded to, Mr Leslie and Mr Shaw write as follows about the supply of water in Loch Doon:—'Of course 'the present supply of water ought to be carefully preserved from 'diminution; and, further, we consider that it would be of immense 'advantage to the mills, the fishings, and to the lowlands adjoining 'the river, which are now liable to be flooded, to increase the 'available storage of Loch Doon, by raising its high-water level. 'This would make it always capable of receiving and storing up 'the summer and autumn floods, which are those which do most 'mischief by inundating the lowlands and carrying off the crops or 'injuring them. The advantages to the mills, fisheries, &c., of a '*storage* of water in Loch Doon, cannot be too strongly impressed 'on the minds of the heritors of the river Doon; for the value of 'the water-power would be most materially enhanced, and in dry 'weather there would be a much larger body of water in the river 'than at present, which would greatly facilitate the ascent of the 'salmon. The present area of the loch, by the Ordnance Survey, 'is fully 1240 acres, and its outlet is such that a large additional 'quantity of water may be impounded at a very small expense.'

At the conclusion of the second part of their Report, they farther write:—'As before stated in the first section of our Report, 'we recommend, both for the sake of the mills and of the fisheries, 'that the storage of Loch Doon should be increased by raising its 'high-water level; by which means, without any damage to 'property beyond flooding a small protion of moorlands on its shores, 'there might be an available depth got of 20 feet. This would 'give a storage of 1080 millions of cubic feet, which would give '4000 cubic feet a minute for six months in the year, in addition to 'the natural flow of the river. This quantity would fill a rect-'angular channel of 12 feet wide and 2 feet 8 inches deep, falling '1 in 4000, or nearly 16 inches per mile. In the event of this 'being done, we consider that it would be necessary to have two 'salmon ladders for the ascent of the salmon; one to be used when

'the loch is not above half full, and the other when it is above 'half full, as it is difficult to adapt one to the varying conditions 'attending so great a rise and fall as 20 feet. Each of the passages 'must be so arranged when in tunnel, as to have air and light over 'the surface of the water, and to have no under current of water 'shooting out through the sluice with such velocity that no fish 'can overcome it. There must be a waste weir of sufficent 'expanse to prevent flooding, and the sluices, &c., must be all placed 'and arranged so as to be easily worked above the level of the 'water in the very highest state of the loch. We are of opinion 'that all these desiderata can be easily achieved, and at a moderate 'expense, considering the objects thereby secured. By thus increas-'ing the constant supply of water from the loch, and, consequently, 'thereby increasing the average flow in the river, anything that 'may be done for the improvement of the dam-dikes would be 'rendered vastly more efficient, and the mill power be much 'enhanced in value.'

A careful personal inspection of the localities referred to has convinced me of the correctness of the views expressed and of the soundness of the advice given in the Report from which the above quotations are taken.

The Ayr.

This river, though the largest of the Ayrshire rivers, is now almost salmonless, owing to pollutions, poaching, want of protection, obstructions, and stake and bag-nets placed too near its mouth. These have produced their usual and inevitable result—the ruin of the fishings; so that the following description given by Mr Buckland and myself in our Report of 1871 is still true of this naturally fine stream:—'The Ayr, as a salmon river, is in a 'very bad state. No weekly close time is observed. There are no 'gratings to the mill-lades. Fry are killed by anglers, colliers destroy 'the breeding-fish at the top of the river, the stake-nets destroy the 'ascending fish at the bottom, and pollutions destroy in the middle. 'If it were the object to extirpate, instead of to preserve and 'increase, that object could hardly be more effectually carried out 'than by the system now adopted. If these evils could be remedied, 'and the proprietors would co-operate in protecting the salmon 'interests, the Ayr might, as in former years, produce tons of salmon 'annually, as the Ayr and the Lugar still continue to possess good 'spawning-grounds.'

There is ample evidence to prove that, in former times, and even at no very remote date, the Ayr was a productive salmon river. A charter of Alexander the Third grants, among other things, a right of salmon fishings in the river to the burgh of Ayr; and, in 1531, a grant was made by the town to the monastery of the Blackfriars, of 'ane piece of land next the seat and place of a 'mylne, and the cruives for fishing of salmon.' In the beginning of last century, the fishings by net and coble were very good, and were the subject of more than one lawsuit; and to come down to more

modern times, when Mr Buckland and I inspected the Ayr in 1870, one witness whom we examined stated that his father, who was an old man at the time of his death, had the fishings in the mouth of the river before stake or bag nets were used, and that he had heard him speak of catching 'cart-loads' of salmon by net and coble, and selling them at 1½d. per pound.

A great deal of pollution is stated to be discharged into the Ayr by the cotton-mills at Catrine, belonging to Messrs James Finlay and Co., about 15 miles from the mouth of the river, which were established in the end of last century, and are very extensive. There are also ammonia works at Muirkirk, which are said to send into the river liquids deleterious to fish life; and the whole of the sewage of the town of Ayr, the slaughter-house refuse, and other impurities, are discharged into the mouth of the river. The *New Cumnock News* of 6th October 1883, under the heading of 'Muirkirk,' has the following paragraph about the pollution from the ammonia works:—'Since the opening of the ammonia 'works here, there has been, from time to time, emptied into the river 'Ayr quantities of a liquid refuse, which has the effect of poisoning 'large quantities of the fish with which the river is stocked. One 'party, who is in a position to know, states that he has seen no 'fewer than seventy dead fish within the past few days. This is a 'serious matter, and will doubtless be seen into. But there is even 'a more serious aspect in this matter. Those who have cattle 'pasturing near the water, run the risk of having them poisoned; 'and apart altogether from the destroying of fish, this damage is not 'to be overlooked. Steps should be taken at once to prohibit the 'emptying of such dangerous refuse into the water before any 'serious damage be done.' There is no District Board on the Ayr, and even if there were, it would be utterly powerless to put a stop to these manifold pollutions, as the clauses in the Salmon Fisheries Acts of 1862 and 1868 to remedy the pollution of rivers and waters have proved notoriously useless. As the law at present stands, it is only a union of the riparian proprietors on the Ayr, founding on the common law rule, that no upper proprietor has a right to pollute the stream to the injury or nuisance of a lower proprietor, that would have any chance of putting an end to the pollutions complained of. Only 400 yards on either side of the mouth of the Ayr is exempted from the operation of stake and bag nets. Beyond and outside this narrow estuary line, they are used during the fishing season in such a way as to capture or intercept the great majority of the salmon seeking the river.

The Irvine.

The Irvine rises not far from the battle-field of Drumclog, in the vicinity of Loudon Hill, and runs into the sea, close to the town of Irvine. It is the second in size of the Ayrshire rivers, having a drainage area of 171 square miles, but it is almost entirely ruined as a salmon river by the chemical works at Irvine and the town sewage, and also by the pollutions poured into it from the manu-

factories of various kinds at Kilmarnock and the town sewage, which are allowed to flow into its tributary, the Kilmarnock water. Yet, on the seashore, only 7 miles distant, in a straight line from Kilmarnock, there is a long stretch of waste land along the curve of Irvine Bay which might be rendered fertile and productive if the town sewage of Kilmarnock, which at present poisons the river, were conducted to it. The examples of Edinburgh, Croydon, Birmingham, and many other towns, show how town sewage can be utilised and made profitable, wherever there is waste land in the neighbourhood; and, in such cases, there seems to be but little excuse for using it to convert what were once productive salmon rivers into open sewers, where scarcely a fish can live.

The Garnock.

The Garnock rises from the Mistylaw Hill, on the borders of Ayrshire and Renfrewshire, and falls into the sea close to the town of Irvine. In Sir John Sinclair's Statistical Account of Scotland, which was published in the last decade of the 18th century, it is stated that the Lugton, the chief tributary of the Garnock, which joins it about a mile below Eglinton Castle, contains plenty of 'very fine trout;' and of the Garnock it is stated that it is well stored with salmon, and with different kinds of fine trout. This, however, is no longer the case. Pollutions, poaching, and general neglect, have made the Garnock almost salmonless. There is no District Board for the Irvine and Garnock. There can be no doubt that the Ayr, Irvine, and Garnock once contained abundance of salmon, grilse, and sea-trout; and they might probably be made to do so again, provided they were properly protected; fixed nets withdrawn to a greater distance from their mouths; dam-dikes made easily passable for ascending fish; pollutions prevented or abated; and no fishing, except by rod and line, allowed in the fresh water for the next 10 years.

From what has been above stated, it will be observed that there is only one District Board—that of the Girvan—for the six Ayrshire rivers. One important and unfortunate result of this is, that no assessments are imposed for the protection of the rivers in which all the salmon are bred; and that the fixed nets on the sea-coast, which get the lion's share of the fishings, pay nothing—or at least are not obliged to pay anything—for their preservation and improvement. Whereas, in a fishery district, like that of the Annan for example, where there is a District Board, and where—as in Ayrshire—by far the most valuable fishings are those arising from fixed nets, these nets have had to pay, for many years past, a yearly assessment imposed by the Board of 4s. per £1, for the protection of the fishings.

A number of the sea-fishings on the Ayrshire coast belong to the

Crown; and a lessee of such fishings, who has had a long and extensive experience of many different stations, expressed to me his opinion that these fishings were too much divided, and that it would be a great improvement to unite several of them into one large fishing let to a single tenant, who could then fish it with fewer boats, nets, and men than would be required with the fishing divided into several smaller fisheries let to separate tenants. 'It 'is no use,' he writes in a letter he has printed on the subject, 'in any man to hope to do good as long as the present state of 'things exists. I would propose that the following fishings be let 'as one,—Carleton, Ardmillan, Bennan, Dahone, and Red Burn. 'With these named let together, Carleton could be fished with 8 'or 10 nets, 1 boat, and 3 men. At present, there are 4 boats, 12 'men, and about 30 nets. If there were less fish, there would be 'less expense and fewer nets, and it would give a chance for fish, 'to get some playground when seeking the rivers that reared and 'gave them protection.'

In conclusion, I may state that the number of mill-lades I have seen during my inspection of the Solway and Ayrshire rivers, without any hecks at the intake or tail-lades to prevent the entrance of salmon, induces me to recommend that, in any future enactment, a clause should be inserted prohibiting fishing for salmon in any lade connected with any mill or manufactory by any net, engine, or device, under a penalty of £5 for each offence, and the forfeiture of the net, engine, or device used in such fishing. It is well known that there is a great deal of poaching in such lades.*

I may also mention that my inspection of the fixed nets in the Solway Firth, and on the Ayrshire coast, has confirmed the opinion which I expressed in my Report on the Salmon Rivers of the East Coast of Scotland, namely, that the weekly close time† applicable to stake and fly nets, which occupy the foreshores or space between high and low water mark, should not be a hard and fast period of thirty-six hours, but should be tidal, commencing at the low water nearest in point of time, before or after six o'clock on Saturday night, and terminating at the corresponding low water, before or after six o'clock on Monday morning thereafter, but so that such weekly close time shall always have a duration of at least thirty-six hours, or whatever other period may hereafter be fixed as the weekly close time. Such a tidal close time applicable to the fixed nets in the district of the Tweed has been in operation for

* As there may possibly be some doubt whether the 6th sub-section of the 15th section of the Salmon Fisheries Act of 1868, which imposes a penalty on every person who does 'any act for the purpose of preventing salmon from passing through any 'Fish-Pass, or taking any salmon in its passage through the same,' is sufficiently stringent to prevent fishing for salmon, or any other kind of fish, in any Fish-Pass, by net, rod, or any other engine or device whatsoever, there ought to be an absolute prohibition of all fishing in a Fish-Pass in any future enactment.

† See that Report, pp. 51 and 52.

more than twenty years, under the 7th section of 'The Tweed 'Fisheries Amendment Act, 1859.'

With regard to bag-nets, on the other hand, which fish in the deep water, where stake nets cannot be used, stress of weather is often pleaded as an excuse for not observing the weekly close time, and disputes are constantly taking place between the officers of District Boards, and the owners or occupiers of these nets, as to whether or not there is sufficient stress of weather to justify the non-observance of the weekly close time. I am, therefore, inclined to think that it might possibly be expedient, in order to put a stop to these constant disputes, to take a month off the fishing season, in the case of bag-nets, and allow them to fish for the rest of the season without observing any weekly close time. The Select Committee of the House of Lords, who reported upon the whole subject of Fixed Engines in Scotland in 1860, recommended that stake and bag nets should either be subject to the weekly close time, or be wholly removed on the 20th July, that is a month before the termination of the ordinary netting season which the Committee recommended. The alternative of subjecting bag-nets to the weekly close time has notoriously proved a failure, and has given rise to endless wrangles and disputes. Might it not be worth while to try the other alternative of taking a month off their fishing season, and letting them fish on continuously during the months left to them?

I have only farther to state that nothing has come under my notice, in the course of my inspection of the Solway and Ayrshire Rivers, to induce me to alter any of the recommendations which I made in my Report on the salmon rivers on the East Coast of Scotland.

I have the honour to be,

Your obedient servant,

ARCHIBALD YOUNG,

Inspector of Salmon Fisheries for Scotland.

The Fishery Board for Scotland.
Edinburgh, *March* 1884.

APPENDIX I.

STATE, showing the result of the Proceedings of the SPECIAL COMMISSIONERS FOR SOLWAY FISHERIES in regard to the FIXED ENGINES in the SOLWAY FIRTH and the RIVERS flowing into the same, 1879.

PROPRIETOR OF FISHINGS.	Used in 1877, as reported by Police Constables.		Claimed as Priviliged.		Certificates of Privilege Granted.		Ordered to be Abated or Removed.	
	Engines	Pockets	Engines	Pockets	Engines	Pockets	Engines	Pockets
DUMFRIESSHIRE.								
I. STAKE, FLY, AND BAG NETS.								
1. Lord Mansfield, . . .	12	34	Not specified	37	11	37	None.	None.
2. Sir F. Johnstone, . .	3	13	3	28	3	28	None.	None.
3. Duke of Buccleuch, . .	2	11	2	11	2	11	None.	None.
4. Burgh of Annan, . .	6	20	Not specified	18	4	14	2*	7
5. Mr Mackenzie of Newbie, .	13	34	Not specified	40	14	36	2†	10
II. PAIDLE NETS.								
1. Mr Mackenzie of Newbie, .	20‡	22	None.	None.	None.	None,	5	5
2. Lord Herries, ...	20§	20	None.	None.	None.	None,	None.	None.
III. POKE NETS.	Clouts.	Pokes.	Clouts.	Pokes.	Clouts.	Pokes.	Clouts.	Pokes.
1. Lord Mansfield, . .	None.	None.	300	1200	30	120	270	1080
2. Burgh of Annan, . . .	579	2315	600	2400	500	2000	100	400
3. Duke of Buccleuch, . .	20	80	None.	None.	None.	None.	20	80
4. Sir F. Johnstone, . . .	10	40	200	800	80	80	180	720

* The Sandrigg and the Tarkettle ranges. Further, the Snabneuk range was restricted to two pockets, the Battlehill range to five pockets, including a runaway, and the Clatty range to three pockets.

† The Arthur range and the Flag Scaur range. Further, the Patten range was restricted to two pockets.

‡ These nets were erected contrary to the wish of the proprietor of the salmon fishings by persons claiming a public right to fish by stake nets for white fish. The proprietor alleged that they were erected and used for taking salmon, and after an inquiry, which was completed as to a few of them, the Commissioners were satisfied that the allegation was proved, and ordered them to be removed.

§ These were erected with the leave of the proprietor of the salmon fishings, but they claimed no certificates of privilege, and no complaint was lodged against them. They were therefore not made the subject of rigid inquiry.

PROPRIETOR OF FISHINGS.	Used in 1877, as reported by Police Constables.		Claimed as Privileged.		Certificates of Privilege Granted.		Ordered to be Abated or Removed.	
	Engines	Pockets	Engines	Pockets	Engines	Pockets	Engines	Pockets
KIRKCUDBRIGHTSHIRE.								
I. STAKE, FLY, AND BAG NETS.								
1. Mr Osward of Cavens, . .	3	11	5	16	5	16	None.	None.
2. Rev. Robinson Douglas (his Trustees), ...	2 and a Basket Net.	3 and a Basket Net.	2 and a Basket Net.	3 and a Basket Net.	1	2	2*	2
3. Mr Ovens of Torr, . . .	1	1	1	1	1	1	None.	None.
4. Mr Mackie of Balcary, . .	2	4	2	4	2	4	None.	None.
5. The Crown, ...	5	5	4	6	None.	None	5†	7
6. Lord Selkirk, ...	6	6	5	5	4	4	2‡	2
7. Burgh of Kirkcudbright, .	4	4	4	4	3	3	1§	1
8. Mr Murray Stewart of Cally,	3	6	1 and a general claim for others.	Not specified.	1	1	3‖	6
9. Mr M'Culloch of Ardwall, .	3	9	6	Not specified.	4	9	2¶	4
10. Sir William Maxwell of Cardoness, ...	4	6	6	12	4	8	2**	4
11. Major Hannay, . . .	4	6	3	9	2	5	2††	4
12. Miss Hughan of Airds, . .	1	3	2	5	2	5	None.	None.
13. Mr Caird of Cassencary, .	2	5	2	5	2	4	None.	None.
14. Mrs Grant of Barholm, .	6	6	4	4	None.	None.	6‡‡	6
15. Mr M'Douall of Logan, .	3	4	None.	None.	None.	None.	3§§	4
II. PAIDLE NETS.								
1. Mr Witham of Kirkconnel, .	2‖‖		None.	None.	None.	None.	None.	None.
2. Mr Oswald of Cavens, . .	5‖‖	5	None.	None.	None.	None.	None.	None.

* Opposite Orchardton, and on south-east side of Whiteport Bay.

† One engine opposite Netherlaw ; two engines opposite Port Mary (one to the south-east of Port Mary House, and one near Abbeyburn foot), and two engines situated respectively on the north and north-east shores of Heston Island.

‡ Merse Yair and Great Cross Yairs.

§ Castledykes Yair, including two flood Yairs, used alternatively.

‖ Three engines situated respectively (1) near Carrick Point, (2) near Craigmore Point, (3) at a place between Airds Bay and Tupstones.

¶ Two engines, (1) at the north end of the Isle of Ardwall running towards Ringdoo Point, and (2) at the south-west of the Isle of Ardwall.

** Two engines, situated respectively opposite Mossyard and Newton Hills.

†† Two engines opposite the lands of Kirkdale, (1) near the foot of Kirkbryde Burn, and (2) to the south thereof.

‡‡ Six fixed engines *ex adverso* of the lands of Barholm.

§§ Three fixed engines opposite Carsewalloch.

‖‖ These were erected with the leave of the proprietor of the salmon fishing, but they claimed no certificates of privilege, and no complaint was lodged against them. They were therefore not made the subject of rigid inquiry.

PROPRIETOR OF FISHINGS.	Used in 1877, as reported by Police Constables.		Claimed as Privileged.		Certificates of Privilege Granted.		Ordered to be Abated or Removed.	
	Engine	Pockets	Engines	Pockets	Engines	Pockets	Engines	Pockets
WIGTONSHIRE.								
STAKE, FLY, AND BAG NETS.								
1. Lord Galloway (his own and Crown Fishings of which he is tenant), . . .	10	Not specified	3	6	3	6	7*	...
2. The Crown, at Cruggleton, Palmallet, Dinnans, and Shaddock, ...	5	Not specified	6	6	None.	None.	6†	6
3. The Crown at Portyarroch,	3	Not specified	2	4	None.	None.	3‡	5
4. The Crown at Garheugh and Corwal, ...	None.	None.	2	4	None.	None.	2§	4
5. The Crown at Synniness, .	6	Not specified	7	Not specified	None.	None.	7‖	...
6. The Crown at Gillespie, .	5	Not specified	4	Not specified	None.	None.	5¶	...
7. Mrs M'Taggart of Ardwell,.	8	Not specified	12	24	3	6	9**	18
8. Mr M'Douall of Logan, .	5	Not specified	8	16	6		3††	6
9. The Crown at Clashwhannan and Killiness, . . .	2	Not specified	None.	None.	None.	None.	2‡‡	...
10. Mr Cunningham's Trustees,	None	None.	3	9	3	9	None.	None.

* Two engines on Wigtown Sands, one engine at Larg Point, one engine at Castle Point, one engine at Garlieston Bay, one engine at Pirate Hole, and one engine at Bay of Rigg.

† Two engines *ex adverso* of the lands of Dinnans, one engine *ex adverso* of the lands of Shaddock, and three engines *ex adverso* of the lands of Cruggleton.

‡ Three engines *ex adverso* of the lands of Portyarroch.

§ Two engines opposite the lands of Garheugh and Cowal.

‖ Seven engines *ex adverso* of the lands extending from the south-eastern boundary of the lands of Synniness in the parish of Old Luce, to a point at high-water mark 650 yards south of Stairhaven Pier.

¶ Five engines *ex adverso* of the estate of Gillespie.

** Nine engines opposite the lands and barony of Ardwell.

†† Three engines, (1) opposite Logan Mill (2) at Myrock Point, (3) at Greenan Point.

‡‡ Two engines, (1) at Clashwhannan Point and (2) at Killiness Point.

APPENDIX II.

MEMORANDUM BY THE SPECIAL COMMISSIONERS FOR SOLWAY FISHERIES as to their Proceedings under the Act 40 and 41 Vict. cap. ccxl.

We have now concluded the work committed to us—of carrying out the Act 40 & 41 Vict. cap. ccxl., and although we have received no instructions to report our proceedings, it may be convenient that we combine in a short narrative a statement of what has been done. Our task has been attended with much more labour, and has occupied much longer time than was at first anticipated. Although the Royal Warrant under which we have acted was signed in August 1877, it was not till October of that year that we had a clerk or secretary, and until he was appointed the work was necessarily at a stand.

It would have been inexpedient to have commenced any public inquiry till the fishing season of 1878 had opened, when we could, by personal inspection, inform ourselves as to the character of the fixed engines we were to deal with, so we endeavoured to utilise the intervening time by ascertaining, through the constabulary of the counties of Dumfries, Kirkcudbright, and Wigtown, the number and construction of the fixed engines actually in use for the capture of salmon at the date of the passing of the Act, and we received from them all the information we expected with great promptitude and general accuracy.

With the aid of this information and the Valuation Rolls of the various counties, we also attempted by correspondence with the coast proprietors to find out the number of fixed engines for which certificates of privilege were to be claimed, and the nature of the titles on which they based their claims to have right to take salmon by means of them.

Had we obtained from the proprietors of the fishings or their tenants the full information and production of titles which we expected, it might have saved a good deal of time. Few, however, responded at once in a distinct and definite form, and we were compelled to fix our statutory courts, which the statute seemed to indicate should be held in the neighbourhood of the fishings, and of which twenty-eight days' notice had to be given, so as roughly to apportion between the towns of Annan, Kirkcudbright, and Wigtown, the time which had been suggested to us as likely to be occupied by our inquiry.

We very soon found that this was inadequate, and in order not to lose the benefit of the advertisements which had been issued, and to save time and expense to all concerned, we had to leave Annan and afterwards Kirkcudbright without having completed the taking of the evidence, adjourning our courts to future days for the conclusion of the evidence, and arranging to hear in Edinburgh any arguments that parties might desire to submit.

Some delay and expense was occasioned by the action of the Commissioners of H.M. Woods and Forests and the tenants of their fishings. Most of the latter at one time claimed temporary certificates of privilege, on the footing that their leases were Crown grants; but, on finding that the Commissioners of Her Majesty's Woods and Forests were making no appearance on behalf of the Crown, most of them declined to insist on their claims.

At a later stage, the Commissioners of Her Majesty's Woods and Forests did lodge claims, and a day was fixed for hearing them, but afterwards they resolved not to appear, and they never fully admitted

that as Solway Salmon Fisheries Commissioners we had any jurisdiction in regard to Crown fishings.

But this point was never fairly argued, and looking to the terms of the instructions in § 3 of 40 and 41 Vict. cap. ccxl., and of the general Salmon Fishing Act, 25 and 26 Vict. cap. xcvii., it was thought that the fixed engines on the fishings claimed on behalf of the Crown must be dealt with on the same footing on which fixed engines on the fishings claimed by subjects were disposed of.

In regard to the fishings on the Dumfriesshire coast, we had the advantage of having all the claims which were put in watched and keenly contested on behalf of other parties interested in English fishings or rivals on the Scotch coast. In only two other cases (one near the mouth of the Urr and the other in the River Cree) had we the advantage of the presence of any contradictor.

After the evidence was complete and counsel and agents heard, the effect of the whole evidence was considered and notes were issued of the situation and dimensions of the fixed engines, which we were disposed to hold proved to have been in use in the years 1861–64, and of difficulties which occurred as to the legality of that use. Some time was subsequently occupied with farther evidence and argument, and much with representations as to the adjustment of the dimensions and situation of the nets, owing to the imperfect manner in which the particulars had been originally furnished.

Ultimately all the cases of fixed engines, between Sarkfoot and the Mull of Galloway, brought under notice were disposed of, and either certificates of privilege or warrants of removal were issued, except in regard to some nets of the kind known as paidle nets.

A table of the results arrived at has been prepared, their substance may be thus stated. As the figures given do not exactly correspond either with the police reports or the claims made, it may be explained that engines *recently used* have been dealt with, whether reported to us or claimed as privileged or not.

I.—Dumfriesshire.

It was reported by the police that there were in use 36 salmon stake nets with 112 pockets.

Claims were lodged for 134 pockets without specifying the number of stake nets.

Certificates of privilege have been granted for 34 stake nets with 126 pockets, and 4 stake nets and 17 pockets were ordered to be removed.

The police also reported the use in 1877 of another class of fixed engines for taking salmon, namely, poke nets which are used in 'clouts' of 3 or 4 pockets each, viz., 600 clouts embracing 2435 pockets.

There were claimed by fishing proprietors 1100 clouts, embracing 4400 pockets.

There have been sanctioned 550 clouts with 2200 pockets; and 560 clouts of 2400 pockets have been ordered to be removed.

A third class of fixed engine known as 'paidle nets' was reported by the police as in use for taking white fish and salmon—40 were reported with 42 pockets.

Mr Mackenzie of Newbie, a proprietor of salmon fishing, appeared and alleged of 13 of these, that they were within his fisheries, and erected and used for the taking of salmon. These nets stand in a very peculiar position. Litigation had been going on between several of the owners of them and Mr Mackenzie, who sought to have them put down, as injurious

to his salmon fishing, and it had been found, by the Second Division of the Court of Session, there was in the public a right of fishing for white fish by stake nets in the sea, and along the shores of the Solway Firth, but this right was to be so exercised as not to interfere with Mr Mackenzie's right of salmon fishing, and all remedies were reserved competent to either party for preventing undue encroachment on, or interference with, their respective rights of fishing. (Gilbertson *v.* Mackenzie, February 2, 1878, Rettie's Reports, vol. v. p. 610.)

Those using these nets admitted that they had no right to fish for salmon, and they claimed no certificates of privilege. In these circumstances it was contended by them that the Solway Salmon Fisheries Commissioners had no jurisdiction to entertain the complaint of Mr Mackenzie.

Being directed by § 3 of the statute under which we were appointed 'to inquire into the legality of all engines erected *or* used for taking salmon,' we held that we were bound to hear the evidence tendered, and having heard it, were satisfied of the truth of the allegation, that they were erected and used for the taking of salmon, and therefore we ordered to be removed such of them as we had seen at the period of our visit to Annan.

The nets are simply small stake nets of the same general form as the ordinary salmon stake nets, with covered pockets, and the ground selected for fixing them is precisely of the same kind as that chosen for the ordinary salmon nets. They are much higher than the poke nets above referred to, and hardly lower than some avowedly salmon nets fixed elsewhere, but they are much lower than the salmon stake nets used in Mr Mackenzie's fishings. They are set as near low-water mark as they can be securely fixed. On appeal, the Second Division of the Court of Session, without looking at the evidence, declined to interfere with the deliverance of the Commissioners, who, they held, had a clear statutory duty which they were bound to perform.

Some questions of considerable practical importance were raised in appeals by the Earl of Mansfield, the Burgh of Annan, and Mr Mackenzie of Newbie.

They have been in the habit of using long ranges of stake nets with many pockets, and each claimed right to treat each pocket as a separate fixed engine, and to set all or any of them any where they pleased along the whole length of their fishery, extending, it may be, to a distance of several miles. To allow this seemed inconsistent with the statutory instruction to state in any certificates granted the situation, and also the size and description of the fixed engines, and therefore effect was not given to this claim, but each range of nets and pockets was treated as a fixed engine. The First Division of the Court of Session adhered to this view on appeal.

As regards the situation,—in the certificates the site or steading stated was that in which the engines were fixed during some of the years 1861–64.

The low water channel varies much in different seasons, being sometimes several hundred yards nearer than at others to the English or the Scotch coast respectively. By the certificates the position of the nets as between the shore and the channel was allowed to be regulated as the fisherman thought most expedient, provided they did not exceed the maximum amount of net and number of pockets granted.

But the sites or steadings of the nets are sometimes silted up with sand, so that no net can be fixed upon them. The fishers have been in use to shift the nets laterally, and fix them on other sites, of which several may be known on the same bank or scaur, sometimes as far apart as 540 yards. This lateral movement was allowed wherever there was evidence of its having taken place during the years 1861–64. The principle of allowing

lateral movement has been extended by the First Division of the Court of Session, irrespective of there having or not having been any shifting of the site during the years 1861–64, provided the new site be on the same bank or scaur mentioned in the certificate.

It will be observed, that even under this greater latitude allowed by the Court, there can be no increase of the fishing powers actually exercised in the years 1861–64.

II.—Kirkcudbrightshire.

The number of fixed engines reported by the Police was 50, with 80 pockets.

Certificates were claimed for 47, with 81 pockets.

The number allowed is 31, with 62 pockets; the number of orders of removal, 27, embracing 40 pockets.

Some orders of removal were pronounced on the ground that the claim had not been substantiated; some, although the use of the engines had been fully proved, because they were situated *in rivers* flowing into the Solway, in which hitherto fixed engines other than cruives had not been allowed; and some, because *in estuaries*, not being in our view estuaries entitled to be considered waters of Solway in the sense of the Act of Queen Mary of 1563, cap. iii., on which Act rested hitherto the exemption of the Solway waters from the general law of fixed engines applied elsewhere in Scotland.

The provisions of the Act, 40 and 41 Vict. cap. ccxl., seemed to us somewhat obscure on many points, more especially as to the effect of the reference in § 3, to the fixing of the limits of the Solway Firth at the Mull of Galloway, under the Scotch Salmon Fisheries Act of 1862. The leading instructions given us are contained in the 3d section and section 4. Thus:

'3. * * * The Commissioners appointed under this Act shall 'inquire into the legality of all fixed engines erected or used for the 'taking of salmon in the waters and on the shores of the Solway Firth 'in Scotland, as the same have been fixed under the authority of "The '"Salmon Fisheries (Scotland) Act, 1862," and in the rivers flowing into 'the same and shall abate and remove all such fixed engines as are not 'proved to their satisfaction to be privileged as hereinafter provided.

'4. In this Act, and in "The Salmon Fisheries (Scotland) Act, 1862," 'and in any Act therewith incorporated, "fixed engine" shall include 'any net or other implement for taking fish fixed to the soil, or made 'stationary in any other way, not being a cruive or mill dam; and '"priviliged fixed engine" shall only include such fixed engines as were 'in use for taking salmon during the open season of one or more of the 'years eighteen hundred and sixty-one, eighteen hundred and sixty-two, 'eighteen hundred and sixty-three, and eighteen hundred and sixty-four, 'in pursuance of any grant or charter or immemorial usage.' * * *

The Salmon Fisheries (Scotland) Act referred to, 25 & 26 Vict. cap. xcvii., enacts, in § 33—

'From and after 1st January 1865, the provisions of 24 & 25 Vict. c. '109, shall extend and apply to salmon fisheries in the waters and on 'the shores of the Solway Firth situate in Scotland, as the same may be 'fixed by authority of this Act, and to the rivers flowing into the same 'in so far as such provisions relate to the use of fixed engines for the 'taking of salmon.'

The English Statute, 24 & 25 Vict. cap. cix., enacts in § 11—

'No fixed engine of any description shall be placed or used for catch-

'ing salmon in any inland or tidal waters . . . but this section shall not 'affect any ancient right or mode of fishing as *lawfully* exercised at the 'time of passing this Act by any person by virtue of any grant or charter 'or immemorial usage.'

Coupling the inquiry directed into the *legality* with the condition of *use* in *pursuance* of grant or charter or immemorial usage, it was thought that the use founded on by claimants of certificates in Scotland must have been *legal use*. This was necessary to make the application of the law in the two countries identical. The words used in the English statute were 'lawfully exercised,' and that was the law which was imported into Scotland.

There were, it appeared to us, two things to be done, in order to give effect to the statute: (1) to restrain the hitherto legal right of proprietors of salmon fishings in Scotland to place as many fixed engines as they pleased on open shores or deep waters, whether in the Solway or elsewhere; (2) to save the old rights, so far as exercised at a certain date. This change in the Scotch law was not to be universal, but only within limits, to be ascertained in a certain way. It was therefore, as we thought, to fix those limits, and set bounds to the territorial jurisdiction of the Commissioners, to restrain the erection of engines that but for the Act would have been legal, that the limits of the Solway Firth were to be ascertained; and they were fixed on the Scotch coast at the Mull of Galloway. It seemed to us that it could not have been intended to save engines, if any such there were, which were not legal at the date of the statute of 1862, as this would have been in contradiction of the object of applying the same rule to English and Scotch fisheries.

Taking this view, we proceeded to inquire into the legality of every fixed engine for taking salmon to the east of the Mull of Galloway brought under our notice, and independently into its privilege, dependent on use during the period mentioned in the Statute in virtue of grant charter or immemorial usage, and only granted certificates when both legality and privilege concurred, and we pronounced orders of removal wherever according to our view either legality or privilege was not established.

The Court held that the Commissioners had no right to inquire into *legality* as a matter separate from 'a right to salmon fishing' and 'use in the years specified.' The effect of this is—

1. Six stake nets have been restored which had been ordered to be removed as situated in estuaries which we held, rightly or wrongly, to be not within the Solway waters as the Act 1563, cap. 3, has been hitherto understood.

2. Seven fixed engines known as yairs in the River Dee, which had been ordered to be removed have been certified as privileged.*

These belong to the Burgh of Kirkcudbright, and to the Earl of Selkirk. The titles of the latter give right to fish salmon in the 'Water 'of Dee,' and admittedly his lordship's engines are even at low tide in the channel of the Dee, as are also those belonging to the Burgh of Kirkcudbright. They are not even like the stake nets near the mouth of the Nith belonging to Mr Oswald of Covens, which were the subject of much litigation, and which were ultimately ordered to be removed as in the river and not in the Solway, though they were fixed on sandbanks which were dry at low water; nor are they, as those nets were near the

* There was no doubt as to there having been immemorial usage in both these classes of cases; but that had never been held in Scotland *per se*, or even combined with title, to give a right to set a fixed engine in an illegal site, nor, up to this time, in a river, even though flowing into the Solway, except in the case of cruives. A fixed engine in the Cree was also restored.

point where the waters of the river flowed into the sea at low water. The lowest of Lord Selkirk's yairs is about three, the highest five miles above that point.

The police also mentioned 7 small nets used for taking both white fish and salmon, as to which see *supra*, p. 138 ; *infra*, pp. 142, 143.

III.—Wigtownshire.

The fixed engines reported by the Police were 44.

The number claimed was 47, with 80 pockets.

Certificates of privilege have been granted for 15, with 33 pockets.

44 engines, embracing 60 pockets have been ordered to be removed, chiefly in connection with Crown fishings.

No appeals were taken in these cases.

Before concluding we may mention that after the judgements of the First Division of the Court of Session above-mentioned were pronounced, applications were made on behalf of several proprietors for special cases or alteration of their certificates. We held that we had no power so to act where appeals had not been taken or not duly insisted in. This has resulted in considerable hardship in several cases.

For instance, so far as we can see, the fixed engines in the River Cree on the fishings of Mrs Grant of Barholm, which we ordered to be removed, stand precisely in the same position as regards privilege with those of the Earl of Selkirk and the Burgh of Kirkcudbright; but Mrs Grant, after having given notice of appeal, intimated her intention of acquiescing in the order of removal, and asked us to interfere with her tenant, who had continued to fish after the date fixed by the order of removal, but gave it up on our remonstrating.

Her claim had been keenly opposed by the Earl of Galloway, an *ex adverso* proprietor, and had Mrs Grant persevered in her appeal, he would have been entitled to appear and be heard for his interest.

Again, Mr Murray Stewart of Broughton and Cally, who for the sake of improving the river fishings had withdrawn all his fixed engines but one during the years 1861–64, thought it would be important that his certificate for that one should be expressed in the terms used by the Court in regard to the Newbie fishings. We considered we had no power to interfere.

In the circumstances above mentioned we felt some hesitation in taking up the case of the nets called paidle nets, and from the conclusion arrived at there will be found difficulty in reconciling the declared right of fishing for white fish with fixed engines and the due protection of the right of salmon fishing. That conclusion we came to after a full inquiry both as to the nets we ordered to be removed and the others complained of by Mr Mackenzie, and the inquiry was extended to other fisheries where similar, though not identical, nets were used. Some of these other nets were used under special licences from the proprietor of the salmon fishery when they were set, and were not so high as those ordered to be removed. They are now set under various restrictions, as, for instance, that they shall not be nearer low-water mark than 300 yards, and that the pockets shall have no covers. Even under these conditions they certainly sometimes catch salmon, but the proprietor could not complain, as he himself regulated the construction of the nets and claimed no certificates for them as privileged fixed engines.

Besides, comparing them with other nets, we had presented to us a great mass of evidence, and had the advantage of seeing and hearing a great many witnesses, and though used also for catching white fish, we did not doubt that they were erected and used for taking salmon. Although farther complaints were made by Mr Mackenzie, and even the Commissioners of H.M. Woods and Forests indicated a wish that orders of removal of nets of this kind should be issued, we were very unwilling to go into inquiries when no right was claimed to certificates of privilege, and restricted ourselves to deciding only as to those few of the nets complained of which we had seen erected or in course of being fixed. We did not see that any decision we might pronounce regarding them could have the same effect as a declaratory judgment by the Court of Session, or could be *res judicata* in regard to any but the actual nets embraced in them. Moreover, after the date of the refusal of the appeal against our deliverance, there did not remain time to conclude any new proceedings with due regard to statutory forms.

Although the Commissioners were not instructed to inquire generally into the capture of salmon in the Solway, and avoided as far as possible doing so where the capture was effected otherwise than by fixed engines, we necessarily became aware, through police reports and otherwise, of various methods employed more or less on both shores of the Solway by which large captures are effected.

There is the whammel net, which is attached to a loaded pole and worked both during the ebb and flood tide, and which we had some difficulty in holding not to fall within the statutory definition of fixed engines.

There are the haave nets, used generally in virtue of licences, the users standing in the water in long rows extending seaward from the shore.

There are drift nets with which the channel is swept, it is said, with no very nice regard to what is the *medium filum.*

There are also the sparling nets, which are said to be most destructive to the young of salmon.

We feel that we should be going beyond our commission were we to make suggestions as to the mode of treatment of salmon fishing as property or as an industry, or as to the reconciling of English and Scotch interests or those of upper and lower proprietors, but we may be permitted to remark that any measure which deals with only one class of engines must necessarily be partial in its operation and stimulate the invention and use of other engines of destruction not falling within the prohibited category.

Signed in name of the Commissioners.

NORMAN MACPHERSON, *C.*

APPENDIX III.

SUGGESTIONS FOR THE IMPROVEMENT OF THE FISHERIES IN THE ANNAN FISHERY DISTRICT. BY AN OLD FISHERMAN. July 1883.

The 14th section of 9th George IV. chap. 39 (1828), should be repealed, as by that section the Solway is exempted from the operation of the Act; and as 7 and 8 Victoria, chap. 95 (1844), is an Act to amend the 9th George IV. chap. 39, the Solway is unfortunately excluded from the operation of that Act also. The 7th and 8th Victoria, chap. 95, makes it an offence 'to fish for fish of the salmon kind' within one mile from low water mark seawards, and the 25th section of 'The Salmon Fisheries (Scotland) Act, 1868, incorporates the 7th and 8th Victoria in it. If the 14th section of the Act of 1828 was repealed, it would then be an offence to fish for fish of the salmon kind, within one mile seawards of low water mark in the Solway. I would also suggest that some more explicit definition should be given as to what 'fishing for and attempting to take salmon' means, with reference to certain recent decisions in which it was held that it was not 'an offence for persons to take salmon while fishing for 'white fish.' Now the law should be more explicit as to what ought to constitute an offence in attempting to take salmon, as for instance, parties setting small stake nets which every person knows are as likely to take salmon as white fish, and are generally set more for that purpose than for the capture of white fish. The Commissioners in 1877 or 1878 inspected what are termed paidle or white fish stake nets in the Annan district, and pronounced them salmon nets, and gave an order of removal to each party who then were using them. The foregoing nets do not only kill large quantities of salmon, but impede the run of salmon, and throw them out of their course, and they have already been declared illegal in the Court of Session during the summer, consequently must be illegal during winter. Notwithstanding the different decisions, they still persist in using these nets, and I would suggest that as a whole they should be abolished as recommended by Messrs Walpole and Young in their Report of 1881. They write as follows:—'We recommend 'that all Paidle nets to the east of the old house of Carsethorn in 'Arbigland should be declared illegal.'

When a person goes out with a boat and draught net to fish for white fish, sparlings, &c., he proceeds to fish only where salmon are to be caught, therefore I think it ought to be made an offence for a person to enter the bounds of a salmon fishery with any nets that are likely to take salmon, or even to land any such nets thereon, without the leave of the proprietor or lessee of the fishing, as white fish can be caught with trawl nets which will not take salmon; I would also cause it to be illegal to fish for salmon with draught nets in any estuary or frith within a defined distance, say one mile from the mouth or entrance to a river, and also where the water, in an estuary or firth, is less than a defined width, also say one mile, so that the nets could not cross from side to side.

The penalties should be higher for fishing without leave, and the

Salmon Fisheries Acts should be excluded from the operation of the Summary Jurisdiction (Scotland) Act, 1881, which binds the magistrate to award a limited term of imprisonment on non-payment of a money penalty, and as offences under the Salmon Acts are all punished by a money penalty, the term of imprisonment is restricted, the magistrate should have the power to award imprisonment without a fine. All cases should be tried before the sheriff.

There would be a difficulty in restricting the Eden Board from claiming the half of the Solway at high water, only I think they ought to be restricted from using the drift or whammel nets, such as are now in operation, as, if this system of fishing is continued, I have no doubt in a short time the fishing in the Solway and in rivers adjacent will be rendered worthless, as at present they use nets stretching across the whole channel, consequently, must prevent fish from getting up the rivers.

APPENDIX No. IV.

LIST of NETS in the RIVER NITH, and ESTUARY thereof, Stewartry of

No.	Name of Owner of Fishery.	Name of Occupier.	Situation of Net.	Distance from Channel.
				Yards.
1	Lord Herries.	Jessie Reid or Walker	Blackshaw Bank.	100
2	,,	Alexander Brown.	,,	59
3	,,	James Laurie.	,,	100
4	,,	,,	,,	150
5	,,	,,	,,	200
6	,,	John Robson.	,,	300
7	,,	,,	,,	300
8	,,	William Ferguson.	,,	250
9	,,	,,	,,	200
10	,,	,,	,,	150
11	,,	Patrick Smith.	,,	60
12	,,	,,	,,	150
13	,,	,,	,,	100
14	,,	Peter Roddan.	,,	200
15	,,	,,	,,	200
16	,,	,,	,,	200
17	,,	Robert Hunter.	,,	300
18	,,	,,	,,	300
19	,,	Archibald Fisher.	,,	250
20	,,	,,	,,	200
21	,,	,,	,,	150
22	,,	Joseph Ross.	,,	100
23	,,	,,	,,	50
24	,,	,,	,,	250
25	,,	George Haydon.	,,	70
26	,,	,,	,,	200
27	,,	James Currance.	,,	300
28	,,	,,	,,	300
29	,,	John Rawline.	,,	200
30	,,	,,	,,	150
31	,,	,,	,,	250
32	,,	James Pearson.	,,	300
33	,,	,,	,,	300
34	,,	,,	,,	300
35	,,	James Ferguson.	,,	200
36	,,	,,	,,	250
37	,,	,,	,,	300
38	,,	William M'Hollam.	,,	200
39	,,	,,	,,	250
40	,,	,,	,,	300
41	,,	William Feiks.	,,	300
42	,,	,,	,,	300
43	,,	,,	,,	170
44	,,	George Hunter.	,,	300
45	,,	,,	,,	300
46	,,	,,	,,	300
47	,,	Thomas Little.	,,	300
48	,,	,,	,,	300
49	,,	,,	,,	300
50	,,	David Edgar.	,,	300
51	,,	,,	,,	300
52	,,	John Rae.	,,	100
53	,,	,,	,,	100
54	,,	,,	,,	300
55	,,	James Hunter.	,,	300
56	,,	,,	,,	300
57	,,	,,	,,	300
58	,,	William Johnstone.	,,	300
59	,,	,,	,,	300
60	,,	,,	,,	300
61	,,	John Edgar.	,,	300
62	,,	,,	,,	600
63	,,	,,	,,	300

APPENDIX No. IV.

in Parish of Carlaverock, Dumfriesshire, and in Parish of Troqueer and Kirkcudbright.

Length of Leading Arm.	Length of Ebb Arm.	Length of Flood Arm.	Have Nets a Cover or Not.	Amount Paid for leave to Fish.	Remarks.
Yards.	Yards.	Yards.			
50	9	10	No.	£2 per Net.	Nets are situated along Blackshaw Bank, on the River Nith, from the west end of said bank to the Lochar, and run nearly from south-east to north-west, facing flood and ebb tides.
35	19	6	,,	,,	
50	11	11	,,	,,	
50	11	11	,,	,,	
50	15	11	,,	,,	
50	11	11	,,	,,	
50	12	12	,,	,,	
50	12	12	,,	,,	
50	11	11	,,	,,	
50	11	11	,,	,,	
50	10	9	,,	,,	
40	8	8	,,	,,	
45	8	8	,,	,,	
50	10	12	,,	,,	
50	11	11	,,	,,	
50	12	12	,,	,,	
50	13	12	,,	,,	
50	15	15	,,	,,	
50	12	12	,,	,,	
50	15	5	,,	,,	
50	12	14	,,	,,	
50	10	10	,,	,,	In Ross's nets three sea-trout weighing from 2 to 4 lbs. In Haydon's net one sea-trout about 1½ lbs.
50	11	11	,,	,,	
50	11	11	,,	,,	
50	12	15	,,	,,	
50	12	15	,,	,,	
50	11	11	,,	,,	
50	10	10	,,	,,	
50	9	15	,,	,,	
50	15	11	,,	,,	
50	12	12	,,	,,	
50	11	11	,,	,,	
50	11	10	,,	,,	
50	11	9	,,	,,	
50	10	10	,,	,,	
50	11	11	,,	,,	
50	12	11	,,	,,	
50	17	10	,,	,,	
50	11	9	,,	,,	
50	11	9	,,	,,	
50	12	9	,,	,,	
50	12	12	,,	,,	
50	12	9	,,	,,	
50	13	10	,,	,,	
50	12	11	,,	,,	
50	11	12	,,	,,	
50	16	10	,,	,,	
50	13	9	,,	,,	
50	15	10	,,	,,	
50	12	9	,,	,,	
50	11	11	,,	,,	
50	12	12	,,	,,	
50	12	12	,,	,,	
50	10	11	,,	,,	
50	11	10	,,	,,	
50	11	12	,,	,,	
50	12	12	,,	,,	
50	11	9	,,	,,	
50	11	11	,,	,,	
50	13	11	,,	,,	
50	12	10	,,	,,	
50	12	11	,,	,,	
50	11	11	,,	,,	

No.	Name of Owner of Fishery.	Name of Occupier.	Situation of Net.	Distance from Channel.
				Yards.
64	Lord Herries.	William Edgar	Blackshaw Bank.	300
65	,,	,,	,,	300
66	,,	,,	,,	300
67	,,	James Edgar.	,,	300
68	,,	,,	,,	300
69	,,	,,	,,	300
70	,,	Andrew Thomson.	,,	300
71	,,	,,	,,	300
72	,,	,,	,,	300
73	,,	James Swan.	,,	300
74	,,	,,	,,	300
75	,,	John Fisher.	,,	300
76	,,	,,	,,	300
77	,,	,,	,,	300
78	,,	William Rawline.	,,	300
79	,,	,,	,,	300
80	,,	,,	,,	300
81	,,	Maxwell Clark.	,,	300
82	,,	,,	,,	300
83	,,	James Milligan.	Kenneth Bank.	300
84	,,	,,	,,	300
85	,,	,,	,,	60
86	,,	Joseph Fleming.	,,	34
87	,,	Jessie M'Burnie.	,,	600
88	,,	James Edgar.	,,	400
89	,,	,,	,,	400
1	R. M. Whitham, Esq.	William Tait.	Galloway side of	7
2	of Kirkconnel.	,,	river.	7
3	,,	Charles Louden.	,,	6
4	,,	,,	,,	9
5	,,	Richard Quin.	,,	12
1	Mr Oswald	William Reid.	,,	300
2	of Auchencruive.	,,	,,	300
3	,,	Samuel Reid.	,,	300
4	,,	,,	,,	300
5	,,	Samuel Landsberry.	,,	300
6	,,	,,	,,	300
7	,,	,,	,,	300
8	,,	Robert Ballantyne.	,,	300
9	,,	,,	,,	300
10	,,	Agnes Ferguson.	,,	100
11	,,	,,	,,	100
12	,,	,,	,,	300
13	,,	,,	,,	300
14	,,	William M'Gee.	,,	300
15	,,	,,	,,	300
16	,,	,,	,,	300
17	,,	John M'Kie.	,,	100
18	,,	John O'Neil.	,,	30
19	,,	John M'Knight.	,,	3
20	,,	,,	,,	6

Length of Leading Arm.	Length of Ebb Arm.	Length of Flood Arm.	Has Net a Cover or Not?	Amount Paid for Leave to Fish.	Remarks.
Yards.	Yards.	Yards.			
50	12	10	No.	£2 per Net.	All the nets on Blackshaw Bank have no covers, but a fly round the top of chamber.
45	12	10	"	"	
45	13	11	"	"	
50	12	8	"	"	
50	13	10	"	"	
50	12	11	"	"	
50	10	12	"	"	
50	10	12	"	"	
50	12	12	"	"	
50	10	9	"	"	
50	11	10	"	"	
50	12	11	"	"	
50	13	12	"	"	
50	11	10	"	"	
50	10	10	"	"	
50	11	12	"	"	
50	11	10	"	"	
50	12	12	"	"	
50	11	10	"	"	
50	12	11	"	"	
41	12	10	"	"	
33	9	7	"	"	
14	9	11	"	"	
10	16	16	"	"	
42	20	12	"	"	
66	19	11	"	"	
39	15	11	Yes.	£1 per Net.	Said nets are situated along the Galloway Bank of the River Nith, from Airds Point to opposite Glencaple, and facing flood and ebb tides.
33	13	10	"	"	
50	13	13	"	"	
40	14	13	"	"	
50	15	12	"	"	
50	11	11	"	"	
48	12	13	"	"	
50	10	11	"	"	
50	13	12	"	"	
50	12	11	"	"	
48	13	9	"	"	Said nets are situated along the Galloway Bank of the River Nith from Carse to Corbly Point, in the parish of Newabbey, and facing flood and ebb tides.
50	10	11	"	"	
50	12	12	"	"	
50	11	13	"	"	
50	11	12	"	"	
46	11	13	"	"	
48	13	11	"	"	
50	12	11	"	"	
50	11	10	"	"	
50	12	10	"	"	
50	10	12	"	"	
48	11	13	"	"	
46	13	11	"	"	
9	16	10	"	"	
27	16	9	"	"	

APPENDIX V.

EXPLANATORY NOTE by Mr LESLIE, C.E., one of the COMMISSIONERS of SCOTCH SALMON FISHERIES, as to the Limits of the SOLWAY FIRTH.

The following is a statement of the facts relating to the issue of the Bye-Law fixing the limits of the Solway Firth :—

By the 6th clause, art. 2, of the Act 25 and 26 Vict. cap. 97 (Salmon Fisheries Scotland Act, 1862), it is provided that the Commissioners 'shall fix, for the purposes of this Act, the limits of the 'Solway Firth, having regard to an Act passed in the forty-fourth year 'of the reign of His Majesty George the Third, cap. 45 (commonly 'called the Solway Act).'

Mr Ffennell and Mr Leslie understood that by that clause the Commissioners were left quite free to fix the limits of the Solway Firth, according to the best of their judgment. Mr Eden, however, was of a different opinion, viz., that they were bound to include every thing within the extreme limits fixed by the so-called Solway Act.

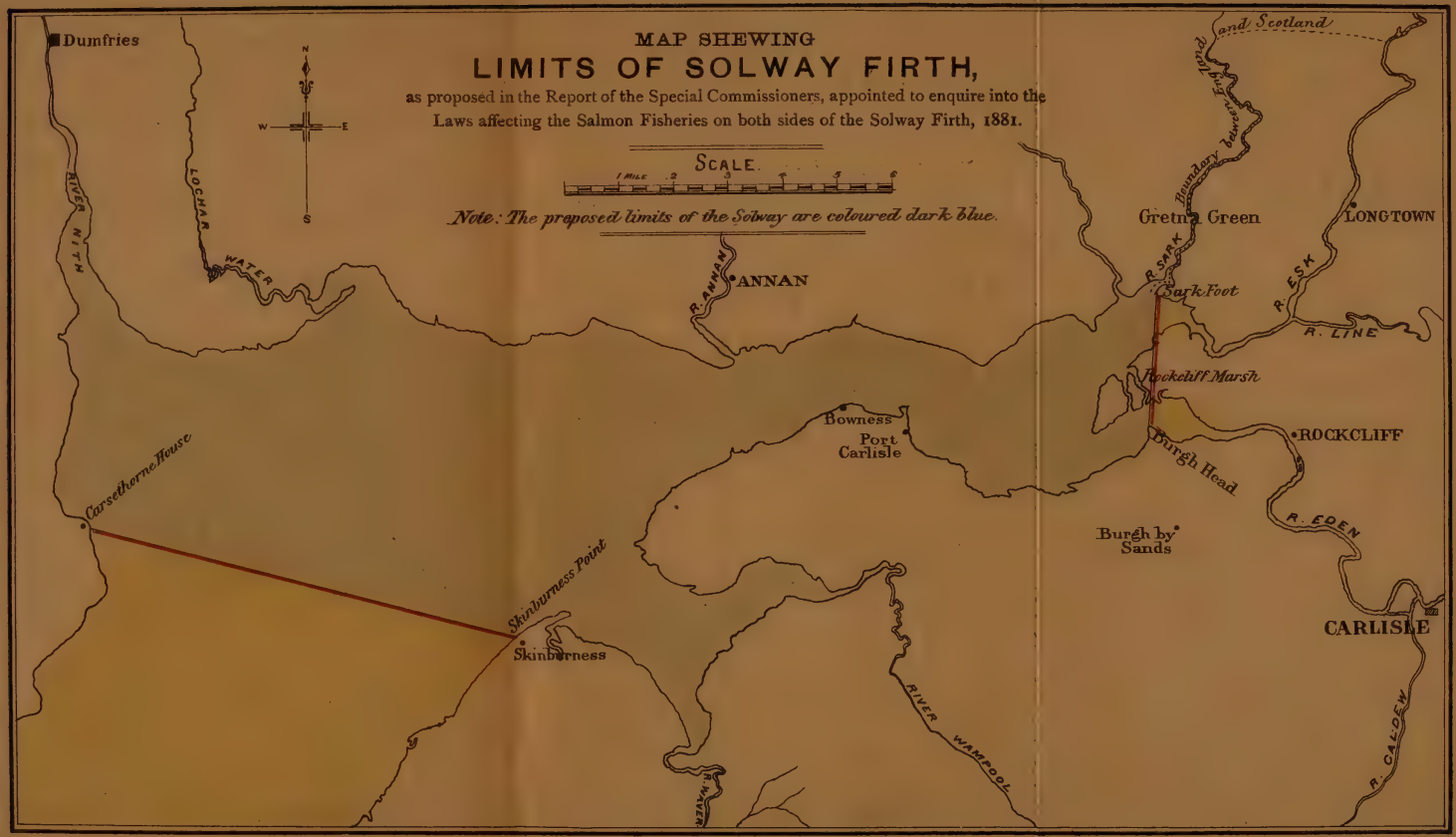
Messrs Ffennell and Leslie thought that such could not be the case, else there was no occasion for any reference to the Commissioners at all, as in that view the Scotch Act of 1862 need only have confirmed the limits prescribed by the Solway Act.

There was, moreover, a dubiety as to what were the limits of the Solway Act referred to, as there were two sets of limits described.

By clause 15 of that Act, a straight line is drawn from the Hotel of Skinberness, in the parish of Abbey Holme, Cumberland, to the large House of Carsethorn of Arbigland in Kirkcudbright, and on that part of the said area of the sea which lies to the eastward of the aforesaid line certain restrictions as to the engines used in fishing are imposed, such as fixing a minimum size for the meshes of nets, providing that any wicker ware or watling shall be not more than six inches in height, and shall have openings, &c., &c.

By section 28 of the same Act it is enacted that, for the sole purposes of executing this Act and no other, the limits of the said arm of the sea shall extend over and across the whole of the said arm of the sea which lies to the eastward of the line above described; and thence westward along the Kirkcudbright and Wigtown coasts for two miles in breadth seawards, as far as the Mull of Galloway, and westward along the Cumberland coast for two miles in breadth seawards, as far as Hodbarrow Point, in the parish of Millam

Lord Advocate Moncreiff gave as his opinion, that by the expression 'having regard to,' the Commissioners were not bound by any limits laid down in the Solway Act, but might use their own discretion in defining the limits; and, therefore, Messrs Ffennell and Leslie fixed on what to them seemed, whether considered geographically or nautically, to be really and truly the Solway Firth, viz., everything which is within the *fauces terrae*, as defined by a line drawn from Ross Head Lighthouse on the north to St Bees Lighthouse on the south, the said line being twenty-six miles in length. Mr Eden not only would not sign the proposed bye-law, as had previously been the practice when one Commissioner differed from the other two, but gave in a remonstrance against it, holding that the Commissioners were bound to take a cord line between the two extreme points laid down by the Solway Act, viz., from the Mull


MAP SHEWING
LIMITS OF SOLWAY FIRTH,
as proposed in the Report of the Special Commissioners, appointed to enquire into the Laws affecting the Salmon Fisheries on both sides of the Solway Firth, 1881.
SCALE.
1 MILE
Note: The proposed limits of the Solway are coloured dark blue.
Dumfries
RIVER NITH
LOCHAR WATER
R. ANNAN
ANNAN
England and Scotland
Boundary between England and Scotland
Gretna Green
LONGTOWN
R. SARK
Sark Foot
R. ESK
R. LINE
Rockcliff Marsh
Bowness
Port Carlisle
ROCKCLIFF
Burgh Head
Carsethorne House
Skinburness Point
Skinburness
Burgh by Sands
R. EDEN
CARLISLE
RIVER WAMPOOL
R. CALDEW

of Galloway on the north to Hodbarrow Point on the south, which line is seventy miles in length, and almost touches the Isle of Man. This last-mentioned line, while it avoids the anomaly in the Solway Act, of having a firth consisting of 145 miles in length of sea-coast only, with no interior to its margin, adds 1034 square miles of sea to what was the area of the largest limits of the said arm of the sea as defined by the Solway Act.

The Home Secretary altered the bye-law as proposed by Messrs Ffennell and Leslie, and adopted the proposal of Mr Eden, but because Messrs Ffennell and Leslie had signed our proposed bye-law, their names were appended to another which was totally different, and which they thought very objectionable and unreasonable, while the name of Mr Eden was not put to it, although he was its author.

The limits of the Solway Firth, as they stand, form exactly a parallel case to what the Firth of Forth would be if it were made to extend from Berwick to Montrose, thereby taking in the Firth of Tay; as the Solway is made to take in Luce and Wigtown Bays, and a great extent of the coasts both of England and Scotland, not looking towards each other, but towards Ireland. There may be good reason for putting two coasts, which face each other, and are geographically within the same Firth, under the same law, but there can be no reason for applying English law to portions of Scotland, varying from twenty-five to fifty-five miles in distance from the nearest part of England, and not facing any part of it.

The present Scotch Salmon Fishery Commissioners are all decidedly of opinion that the limits of the Solway Firth ought to be restricted to a line drawn from Ross Head Lighthouse to St Bees Lighthouse, including the middle of the Firth as well as its margins. An explanatory map accompanies this note.*

EDINBURGH, *3rd April* 1868.

* This map will be found opposite page 79 of the Appendix to the Report of 1871, by Mr Buckland and myself, on the effect of recent legislation on the Salmon Fisheries in Scotland, and also opposite page 21 of the Appendix to the Report of 1881, by Mr Spencer Walpole and myself, on the Laws affecting the Salmon Fisheries of the Solway Firth.

APPENDIX G.—No. II.

REPORT to the FISHERY BOARD FOR SCOTLAND, by ARCHIBALD YOUNG, Advocate, Inspector of Salmon Fisheries, on the Rivers and Lochs that would be opened up to Salmon by placing an efficient Salmon-Ladder on the Falls of Tummel.

I have the honour to report that, during the first week of the present month, by the direction of this Board, I carefully inspected the series of streams and lochs in the fishery district of the River Tay above the Falls of Tummel. These falls at present form almost a complete barrier to the ascent of salmon, and shut out upwards of 100 miles of rivers and lochs well adapted for spawning and angling purposes.

There would be no difficulty in constructing, at a moderate cost, a salmon-ladder which would enable salmon to ascend the falls with perfect ease, and so stock the miles of fine spawning ground that await them in the rivers above, and likewise the deep and spacious reservoirs of Loch Tummel, Loch Rannoch, Loch Ericht, and Loch Laidon. The Falls of Tummel are only 16 feet high. Far higher falls, with a much greater body of water passing over them, have been made accessible to salmon in the United States and in Norway; and a fishway on the Macdonald system would almost certainly enable salmon to surmount the Falls of Tummel with facility, while the expense of such a pass would not exceed £250.

The proprietors of the falls are Mr Butter of Faskally and Mr Barbour of Bonskied. The first of these gentlemen, it is understood, claims compensation for any loss to his fishings below the falls which might result from the putting in of a pass which would enable salmon to ascend them and reach the upper waters, while the latter objects to the loss of amenity which such an interference with the falls might cause.

According to the existing Salmon Fishery Acts, District Boards can put a fish-pass on a water-fall only by agreement with the proprietor or proprietors. They have no compulsory powers to construct a fish-pass, however great the benefits that would accrue to the Salmon Fisheries in their district by making the fall passable. If the owners object, the Board is powerless. The 13th section of 'The Salmon Fisheries (Scot-'land) Act, 1868,' is the law which at present regulates this matter, and it provides that 'the District Board shall, by agree-'ment (which agreement any heir of entail or other person under 'disability, is hereby empowered to make with such Board, and to 'implement), have power to purchase, for the purpose only of 'removal, any dam, weir, cruives, or other fixed engines they may

'deem it expedient to remove for the benefit of the fisheries in their 'district, and to remove any natural obstruction to the passage of 'fish in the bed of a river, *or to attach a fish-pass to any waterfall.*'

The Tay District Board, who have had this matter under their consideration for the last fifteen years, are unanimous in thinking that the vast extent of water above the falls should be salmonised by the erection of an efficient fish-pass. But, as above stated, they are powerless without the consent of the owners. This, likewise, was the conclusion arrived at by the late Mr Frank Buckland and myself, after a careful examination of the falls in 1870; and, at page 19 of our Report of 1871 on the effect of recent legislation on the Salmon Fisheries in Scotland, we write as follows:—'The Falls 'of Tummel keep the fish out from Loch Tummel, Loch Rannoch, 'Loch Ericht, and Loch Lydoch, and from tributaries that extend 'as far as the deer forest of the Black Mount—in all, from about '100 miles of water. The Tummel rushes through a narrow gorge 'between two high rocks with such violence that it is almost im-'possible for fish to ascend it. The height of the falls is about 15 'feet perpendicular. . . . It should be mentioned that salmon 'have occasionally passed these falls, and have been captured in 'Loch Tummel; but these were rare and exceptional instances, and 'in general, the falls act as a complete barrier to the passage of fish 'to the fine and extensive spawning grounds above.'

Afterwards, on page 22 of the same Report, we write as follows:— 'In conclusion, as regards the legislation relative to natural obstruc-'tions, we agree, *in the first place*, that the salmon fisheries of Scot-'land would be greatly improved if the natural obstructions we have 'mentioned were opened up. Could this be done, many hundreds 'of miles of rivers and lochs now destitute of salmon would be 'stocked with these valuable fish, and a vast area of spawning 'ground would be added to the Scotch rivers which would im-'mensely increase their salmon-producing capabilities. The maps 'in the appendix, showing the extent of water that would be made 'accessible to salmon by opening up the Falls of Tummel and the 'Falls of Mounessie only, will show clearly how much might be 'done by well-applied exertions in this direction. *Secondly*, We 'think that compulsory power should be given to District Boards 'to make these obstructions passable for salmon, the District Board 'paying the expense. *Thirdly*, That where a District Board seeks 'for compulsory power to do this, the question should be examined 'publicly by a court held by the Scotch Commissioners, or other 'salmon fishery officials, and that the sanction of the Home Office 'should be given before the necessary operations are undertaken. '*Fourthly*, Wherever natural obstructions serve no industrial pur-'pose, such as diverting water for mills and manufactories, but are 'an impediment and hindrance to the salmon capabilities of the 'Scottish rivers, we think that private rights, founded only on the 'argument of amenity, should give way to the public interest. 'Passes, indeed, may be made over several of these falls without 'any diminution of amenity.'

I have now most carefully inspected, chiefly on foot, the whole of the waters above the Falls of Tummel, and I am therefore in a posi-

tion to be able to state that their spawning and angling value is immense—far beyond what I had any previous idea of. The distance, measuring by water, through a continuous chain of rivers and lochs, from the Falls of Tummel to the head of Loch Ba, in the Black Mount, and to Loch na Gannaich, which is within an hour's walk of Kingshouse at the head of Glencoe, is between 50 and 60 miles, of which about one-half are lochs, and the remainder rivers with beds of gravelly spawning ground where hundreds of salmon might breed, and with deep pools and rapid streams which would afford first-rate angling were salmon enabled to reach them. Proceeding in another and more northerly direction, it will be found that the distance, by an unbroken series of rivers and lochs, from the Falls of Tummel to the head of Loch Ericht, near Dalwhinnie, is not less than 55 miles, of which 26 are rivers, and the remainder lochs. All the waters within this vast watershed, at present salmonless, would be opened up to salmon by placing an efficient fish-pass on the Falls of Tummel. The area covered by Loch Tummel, Loch Rannoch, Loch Ericht, Loch Laidon or Lydoch, and Loch Ba is 20,000 acres, or 31 square miles, and the length of the Tummel above the Falls of the Ericht, and of the Gaur, without reckoning their tributary streams, is 30 miles.

I shall now proceed to describe more particularly the rivers and lochs above the Falls of Tummel. For fully two miles above the falls the bed of the river is rocky and unsuitable for spawning purposes, but there are deep pools and streams which would be favourite haunts of salmon if they could reach them. There are a good many pike here; and in Loch Tummel they are occasionally got 20 lbs. weight and upwards. These, of course, would prove destructive to salmon fry, if salmon were enabled to ascend the falls and spawn above them. But, if salmon were enabled to ascend freely, means might be found to thin out the pike, especially during their spawning season. The five miles of the river nearest Loch Tummel present much good spawning ground, as well as fine angling pools. Then comes Loch Tummel, about 4 miles long, famous for the size and quality of its trout, which, however, are rather shy. Above and beyond the head of the loch, the river for some distance pursues a very winding and circuitous course, and is deep and still, except when a strong breeze strikes it. There are 12 miles of water, following the windings of the stream, between Lochs Tummel and Rannoch, and it must be remembered that all this is a broad full river, suitable for the largest salmon. Here also there are a multitude of streams and pools, fitted for spawning or angling, though there are about 3 miles of the river where the rockiness of the bed affords no ground adapted for spawning. On one part of this stretch of water, near the march between the Duke of Atholl and Mr Tennent of Dunalastair, there is a considerable fall and rapid; but it would not be sufficient to stop the upward progress of salmon, if a salmon-pass were placed on the Falls of Tummel, and it might very easily be improved at no great expense. This fall is said to have the effect of preventing the ascent of pike into Loch Rannoch.

We now reach Loch Rannoch, a spacious sheet of water 10 miles

long by a mile wide, and in some places 90 fathoms deep. It is 668 feet above the level of the sea. It receives a few tributaries on its north and south sides, in which there is good spawning ground; but its chief feeders are the Ericht and the Gaur. The former flows into it on the north side, about a mile below Rannoch Lodge, issuing from the foot of Loch Ericht, a great expanse of water 15 miles long, hemmed in on both sides by lofty mountains, and varying in breadth from a mile and an eighth to a quarter of a mile; while the latter—a stream three times the size of the Ericht—connects Loch Laidon, whose upper waters are in the Black Mount Deer Forest, with the head of Loch Rannoch. I walked up the Ericht from its junction with Loch Rannoch to its source in Loch Ericht, a distance of about 6 miles. The bed of the stream is rocky and unsuitable for spawning purposes for a considerable distance up to where it is joined by the Alt Glass Burn; but between that burn and the foot of Loch Ericht, a distance of about 2 miles, there is much good spawning ground and some capital angling pools. About 1½ mile up the stream, from where it joins Loch Rannoch, there is a considerable waterfall on the Ericht, which salmon could scarcely ascend in its present state, but it could easily be made accessible; and the proprietor, Sir Robert Menzies, Bart., will undertake to do this in the event of an efficient salmon-pass being placed on the Falls of Tummel. The narrow gorge where this fall dashes over the rocks is known as 'Struan's Leap,' so called from a Robertson of Struan, who cleared it at a single bound when hard pressed by his pursuers.

The Ericht flows out of the eastern corner of the south extremity of Loch Ericht, and a good spawning burn of considerable size, called the Canachrochan Burn, flows into the western corner. I walked back to the head of Loch Rannoch, along the skirts of the Rannoch Deer Forest, then crossed the Alt Chalder—a full, deep burn with a fine gravelly bottom—which passes through a small loch and then flows into the Gaur.

Next day I walked along the whole course of the Gaur and along part of the shores of Loch Laidon. The Gaur is a splendid stream, as large as the Tummel. It has a course of 7 miles, and unites the wild and remote Loch Laidon, 924 feet above the level of the sea, with the head of Loch Rannoch. In it there are many grand angling streams and pools, and a large extent of excellent spawning ground. It has everything to attract and multiply salmon, and it is a great pity that they are debarred from reaching it. A good many tributary streams flow into each side of the Gaur. On the right bank it receives the Alt Chomrie and the Alt Dubh, both of which have some good spawning ground in the lower part of their courses, and good lies for salmon; but on the latter, about a mile above its junction with the Gaur, there are two waterfalls close to each other, and each nearly 20 feet in height, which would, of course, effectually bar the farther progress of ascending fish. There is a deep pool beneath the lowest of the two falls, where salmon might probably be found in the latter end of the season, if they were enabled to reach the Gaur. On the left bank

the Gaur receives the Alt Chalder Burn and the Alt Eigheach, a very good trouting stream, which rises in the Rannoch Deer Forest. There are falls and a long rapid on the Gaur about 3 miles from Loch Rannoch, the river flowing for a considerable distance through a picturesque rocky gorge. But, on the left bank of the stream, there is a beautiful example of a perfect salmon-ladder, constructed by Nature's own hand, which passes round the falls by a series of easy consecutive pools, each pool a foot or two above that immediately below it, while about the centre of the ladder there is a spacious basin, where ascending fish may rest on their upward journey. Were salmon enabled to ascend to the Gaur they would have no difficulty in surmounting the falls by means of this natural fish-way, and so reaching Loch Laidon.

Nearly midway in its course, the Gaur expands into a small loch, called Loch Eigheach, which has a gravelly bottom; and, as the stream of the river is perceptible throughout it, it would probably become a favourite spawning place for salmon. For nearly 3 miles above Loch Eigheach, the Gaur presents many splendid angling streams and pools, and likewise, in several places, good spawning ground. Then comes another small loch, and lastly Loch Laidon, the ample reservoir from which it flows. This remote and dreary loch is 7 miles long. It traverses the Moor of Rannoch and part of the Black Mount Deer Forest, and its upper extremity is not above 4 or 5 miles from the inn at Kingshouse, near the head of Glencoe. About two-thirds of the way up, it divides into two branches. Two small rivers flow into the head of it, termed the Alt na gannich and the Ba, the former into the northern and the latter into the southern branch. A mile and a half above Loch Laidon, the Ba spreads out into a considerable lake called Loch Ba, $2\frac{1}{2}$ miles long and $\frac{3}{4}$ mile wide. The river Ba has a course of $4\frac{1}{2}$ miles above this loch and $1\frac{1}{4}$ mile below it. There is also a smaller loch on the other feeder of Loch Laidon, the Alt na Gannich.

I have now concluded the narrative of my survey of the lochs and rivers which would be opened up to salmon by placing an efficient fish-pass on the Falls of Tummel; and I beg to express a most decided opinion that the sooner such a fish-pass is constructed the better. It would greatly increase the market supply of a most valuable and popular fish. It would be a substantial boon to the upper proprietors, to whom it would afford sport and recreation and largely augmented rentals, in the event of their letting their fishings, while the lower proprietors would also benefit from the greatly increased area of spawning ground which would be opened up, and the consequently increased number of salmon that would be bred. In short, it seems to me unquestionable that, until such a fish-pass is placed on the Falls of Tummel, the resources of the extensive basin of the Tay as a salmon-producing river can never be fully or adequately developed.

For sometime after the placing of an efficient fish-pass on the Falls of Tummel, it would, I venture to think, be expedient to combine with it one or two hatcheries on the Ericht or Gaur, or some of their tributaries, in order to breed salmon artificially and

let the smolts down to the sea, and so induce them to return in the latter part of the season to their native streams.

I would beg to point out that the area of rivers and lochs that would be opened up by putting a salmon-ladder on the Falls of Tummel would be about one-fifth of the whole amount of water in Scotland at present barred against the ascent of salmon by unpassable waterfalls. This, I estimate at between 500 and 600 miles. It would be a grand, and, I have no doubt,* a successful experiment, to inaugurate the opening up this vast extent of lake and river by commencing with the Falls of Tummel, and I respectfully venture to express a hope that the Board will recommend that it be carried out. How successful and remunerative such an experiment may be, is shown in the case of the fishery at Ballisodare, county Sligo, Ireland. At the mouth of the river there are three falls, altogether 50 feet in height, which were perfectly impassable to salmon, until Mr Cooper, the proprietor, took steps to make them accessible. The salmon-ladders which he constructed allowed the fish to find their way to the upper streams and lakes. These ladders enabled them to pass, first, the perpendicular rock of 20 feet, over which the river falls into the tideway; second, the falls at Ballisodare mills; and lastly, the falls at Colloonay. Before the construction of these ladders, not a single salmon had ever surmounted the falls; but, after their construction, they were able to ascend with the greatest ease. A valuable and productive salmon fishery was, in fact, created, where none had previously existed; and 11 years after the ladders were placed on the falls, 10,000 salmon were caught in a single year in the waters above them. What was done at Ballisodare might likewise be done at the Falls of Tummel.†

I may mention that the 73rd clause of the Scotch Salmon Fishery Bill of 1861, which was prepared and brought in by Lord Moncrieff, then Lord Advocate, and by the late Sir George Lewis, contained the following stringent provisions with regard to placing salmon-ladders on natural obstructions:—'If any natural obstruc-
'tion shall exist in any river which prevents the free passage of
'salmon, salmon-ladders shall be constructed, so as to permit and
'allow such passage at all times over, across, or through the same;
'and if the owner of the soil, land, or fishery, in or upon which
'such obstruction exists, shall refuse or neglect to allow such
'salmon-ladder to be constructed, within 14 days of being there-
'unto required in writing by the Central Board or their Secretary,
'or by the District Board or their clerk, or by any surveyor or
'inspector, it shall be lawful for the Central Board, or for the Sheriff
'within whose jurisdiction the obstruction or cause of interruption

* Details with regard to the principal natural obstructions in our Scotch salmon rivers, and the extent of water from which they shut out salmon, will be found in my treatise on 'Salmon Fisheries' in the volume of Stanford's series of 'British Industries,' entitled *Sea and Salmon Fisheries*, pp. 236, 239.

† A map, showing the extent of rivers and lochs that would be opened up to salmon by placing an efficient fish-pass on the Falls of Tummel, forms Appendix III. to my Report of last year to the Fishery Board for Scotland on the Salmon Rivers on the East Coast from Forth to the Kyle of Sutherland, both inclusive.

'is wholly or partially situated, upon the application or informa-
'tion of the clerk of the District Board respectively, to order and
'direct that such salmon-ladder shall be constructed by or under
'the inspection or direction of a proper person to be appointed by
'the Central Board or District Board, or such Sheriff, and at the
'expense of the District Board, in such manner as may sufficiently
'effect the object intended with the least possible injury to the pro-
'perty of such owner.'

I have only farther to state, in conclusion, that I had the pleasure and advantage of being accompanied and assisted in my inspection of the rivers and lakes above the Falls of Tummel by Sir Robert Menzies, Bart., and Admiral Maitland Dougall, both members of the Tay District Board, and by Mr John Dickson, W.S., Clerk to that Board.

I have the honour to be,

Your obedient servant,

ARCHD. YOUNG.

THE FISHERY BOARD FOR SCOTLAND,
Edinburgh, 8*th May* 1884.

SECOND

ANNUAL REPORT

OF THE

FISHERY BOARD FOR SCOTLAND

For the Year ended 31*st December* 1883.

Presented to both Houses of Parliament in pursuance of Act 45 and 46 Vict., cap. 78.

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1884.

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